0031119

Tri-Party Agreement

Record of Decision

USDOE Hanford 1100 Area

Hanford Site
Richland, Washington

September 1993

Washington State Department of Ecology ▲ U.S. Environmental Protection Agency ▲ U.S. Department of Energy

DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

USDOE Hanford 1100 Area
Hanford Site
Benton County, Washington

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected remedial actions for the USDOE Hanford 1100 Area, Hanford Site, Benton County, Washington, which were chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

The State of Washington concurs with the selected remedy.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response actions selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to the public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy for the 1100 Area NPL Site addresses actual or threatened releases at the four 1100 Area Operable Units: 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1.

The major components of the selected remedy include:

1100-EM-1 Operable Unit

- Capping the Horn Rapids Landfill.
- Offsite disposal of PCB contaminated soils.
- Offsite incineration of soils contaminated with bis (2-ethylhexyl)phthlalate.
- Natural attenuation of groundwater that currently exceeds MCL's and monitoring for compliance.

- Continuation of institutional controls for groundwater and land use at the Horn Rapids Landfill.

1100-EM-2, EM-3 and IU-1 Operable Units

- Offsite disposal of soils, debris and structures contaminated with solvents, PCBs and other hazardous substances.

- Continuation and expansion of groundwater monitoring.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, will comply with federal and state requirements that are legally applicable or relevant and appropriate to the remedial action, and is cost effective. This remedy utilizes permanent solutions to the maximum extent practicable for this site, and satisfies the statutory preference for remedies that employ treatment that reduces toxicity, mobility, or volume as a principal element. Alternative treatment technologies were evaluated for this site, but are not included in the selected remedy.

Because this remedy will result in hazardous substances remaining on site above health-based levels, a review will be conducted within 5 years after commencement of remedial action to ensure that the remedy continues to provide adequate protection of human health and the environment.

Signature sheet for the Record of Decision for the USDOE Hanford 1100 Area Final Remedial Action between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

Gerald A. Emison
Acting Regional Administrator, Region 10
United States Environmental Protection Agency

9-24-93
Date

Signature sheet for the Record of Decision for the USDOE Hanford 1100 Area Final Remedial Action between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

John D. Wagoner

9/30/93

John D. Wagoner
Manager, Richland Operations
United States Department of Energy

Date

Signature sheet for the Record of Decision for the USDOE Hanford 1100 Area Final Remedial Action between the United States Department of Energy and the United States Environmental Protection Agency, with concurrence by the Washington State Department of Ecology.

D Butler

Drusilla Butler
Program Manager, Nuclear and Mixed Waste Program
Washington State Department of Ecology

Sept 30 1993
Date

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DECISION SUMMARY

INTRODUCTION

The U.S. Department of Energy's Hanford Site was listed on the National Priorities List (NPL) in July 1989 under authorities granted by the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980 as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. The Hanford Site was divided and listed as four NPL Sites: the 1100 Area, the 200 Area, the 300 Area, and the 100 Area.

In accordance with Executive Order 12580 (Superfund Implementation) and the NCP, the U.S. Department of Energy (DOE) performed a Remedial Investigation (RI) for the 1100-EM-1 Operable Unit, which characterized the nature and extent of contamination in groundwater and soils near the 1100-EM-1. A baseline risk assessment, comprised of a human health risk assessment and an ecological risk assessment, was conducted as part of the RI to evaluate current and potential effects of 1100-EM-1 contaminants on human health and the environment. DOE also performed a focused Remedial Investigation (RI) for the remaining three 1100 Area operable units (1100-EM-2, 1100-EM-3, and 1100-IU-1), which characterized the nature and extent of contamination in groundwater and soils near these Units. A qualitative baseline risk assessment (an evaluation of overall potential risk from these operable units made by comparing possible waste site contaminant levels with existing State and Federal health-based guidelines), was conducted as part of the focused RI to evaluate potential effects of contaminants on human health and the environment.

I. SITE NAME, LOCATION, AND DESCRIPTION

The Hanford Site is a 560-square mile Federal facility located along the Columbia River in southeastern Washington, situated north and west of the cities of Richland, Kennewick, and Pasco, an area commonly known as the Tri-Cities (Figure 1). The 1100 Area NPL Site is located in the southern portion of the Hanford Site, and covers less than 5 square miles. Operable Units 1100-EM-1, 1100-EM-2, and 1100-EM-3 are located in the southernmost portion of the Hanford Site and contain the central warehousing, vehicle maintenance, and transportation distribution center for the entire Hanford Site (Figure 2). 1100-IU-1 is located on the northeastern slope of the Rattlesnake Hills, approximately 24 kilometers (km) (15 miles) from the 1100 Area. The site is a former NIKE missile base and control center, and is now used for the Arid Lands Ecology (ALE) Reserve Headquarters.

The land surrounding Hanford is used primarily for agriculture and livestock grazing. The major population center near Hanford is the Tri-Cities, with a combined population of nearly 100,000. The southwestern area of Hanford, covering 120 square miles, is designated as the Arid Lands Ecology Reserve and is managed by DOE for ecological research.

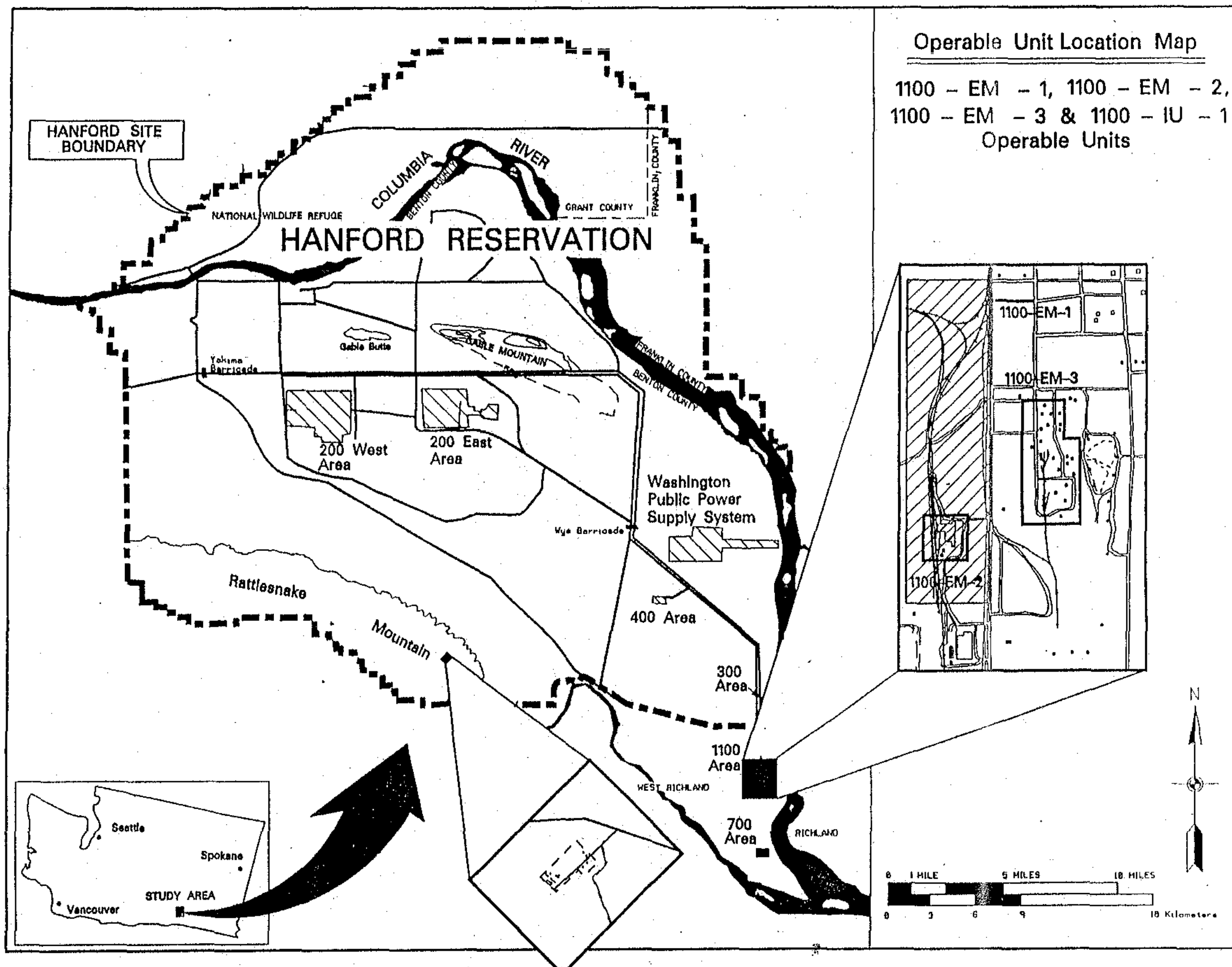

Figure 1

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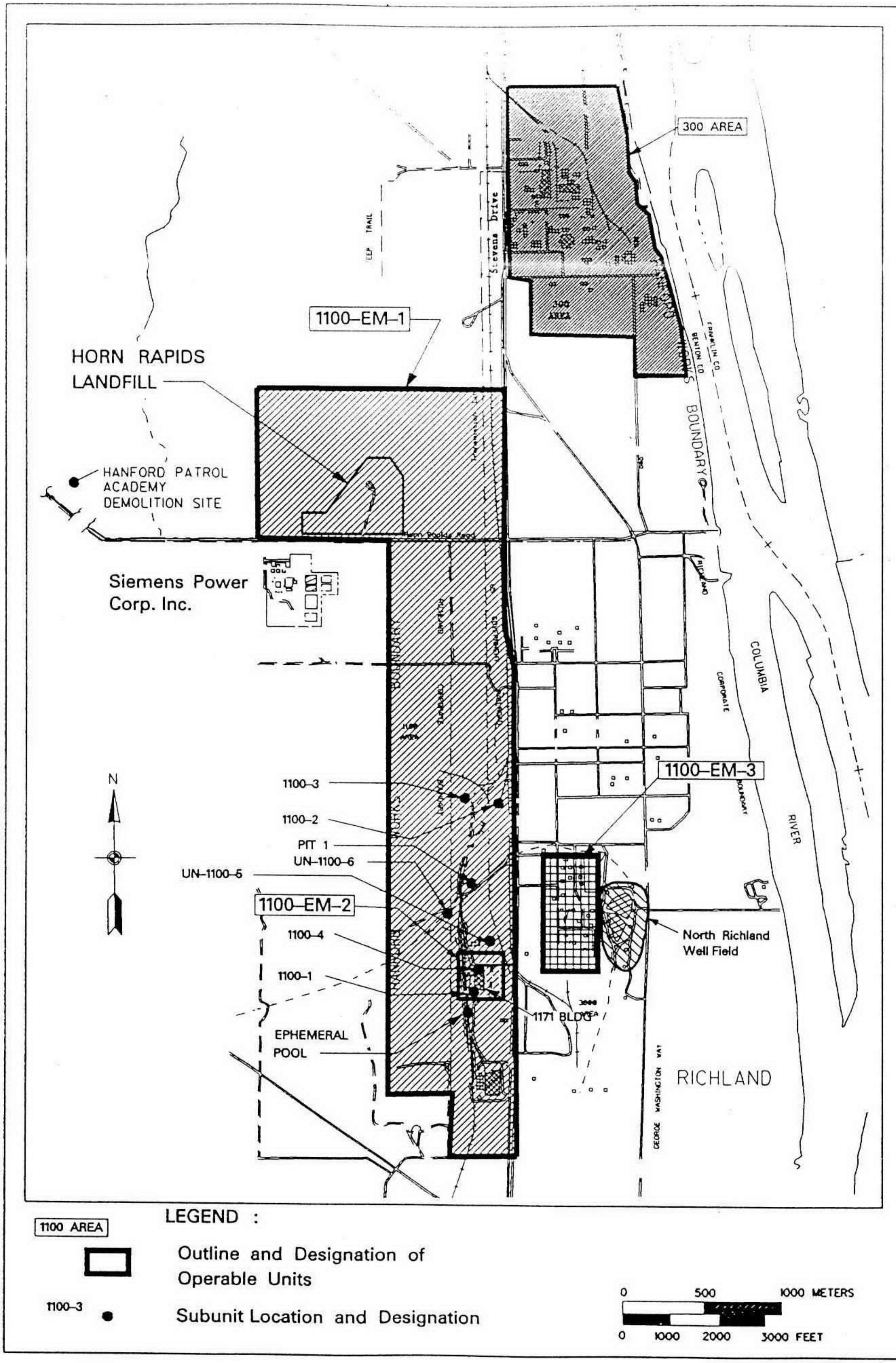
Figure 1



Operable Units 1100-EM-1, 2 & 3 with Subunits.

Figure 2

The North Richland Well Field is located 0.8 km east of the 1171 building and is used to supplement city of Richland water supplies. Columbia River water is pumped to the well field and then percolates through the soil creating a groundwater mound. The City then extracts water from this mounded area as needed to supplement the water supply from the water treatment plant. This procedure reduces turbidity and improves water quality for industrial and residential usage.

Semi-arid land with a sparse covering of cold desert shrubs and drought-resistant grasses dominates the Hanford landscape. Forty percent of the area's annual six and one quarter inches of rain occurs between November and January. In part due to the semi-arid conditions, no wetlands are contained within the boundaries of the 1100 Area NPL Site.

The Columbia River is located approximately one mile east of the 1100 Area. The 1100 Area is not within the 100 year flood plain of the river.

II. SITE HISTORY AND ENFORCEMENT ACTIONS

The Hanford Site was established during World War II as part of the Army's "Manhatten Project" to produce plutonium for nuclear weapons. Hanford Site operations began in 1943, and DOE facilities are located throughout the Site and the City of Richland. Much of the land that Hanford now occupies was ceded to the government by treaty with various Native American tribes. Certain portions of the Site are known to have cultural significance and may be eligible for listing in the National Register of Historical Places.

In 1988, the Hanford Site was scored using EPA's Hazard Ranking System. As a result of the scoring, the Hanford Site was added to the NPL in July 1989 as four sites (the 1100 Area, the 200 Area, the 300 Area, and the 100 Area). Each of these areas was further divided into operable units (a grouping of individual waste units based primarily on geographic area and common waste sources). The 1100 Area NPL site consists of four operable units (1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1).

In anticipation of the NPL listing, DOE, EPA, and Ecology entered into a Federal Facility Agreement in May 1989. This agreement established a procedural framework and schedule for developing, implementing, and monitoring remedial response actions at Hanford. The agreement also addresses Resource Conservation and Recovery Act (RCRA) compliance and permitting.

The North Richland well field has been of particular interest during the course of the 1100 Area investigation. Located 0.8 km east of the 1171 building, the well field is still used to supplement city of Richland water supplies. Initial concerns focussed on the impact of possible migration of potential contaminants from the 1100 Area to the well field.

The 1100-EM-1 Operable Unit contains several individual waste sites. These sites are:

- 1100-1 (The Battery Acid Pit): An unlined, sand-filled sump, or french drain approximately 30 m (100 ft) from the southwest corner of the 1171 Building, used for disposal of waste acid from vehicle batteries. During its use, the pit was approximately 1.8 m (6 ft) in diameter and 1.8 m deep. The pit is no longer visible because it was filled and graded to match the surrounding surface when it was removed from service. Historical documents record an estimated 57,000 liters (L) [15,000 gallons (gal)] of battery acid wastes may have been disposed of during its operating years (1954 to 1977).

- 1100-2 (The Paint and Solvent Pit): A semicircular depression located approximately 1.6 km (1 mile) north of the 1171 Building. Originally a sand and gravel pit, the site was used during the period between 1954 through 1985 for the disposal of construction debris generated during demolition of Hanford Site facilities. Principal components of the waste include concrete rubble, asphalt, and wood debris. Undocumented disposal of waste paint, solvent, and paint thinner is also reported to have occurred at this site. The pit has an approximate diameter of 108 m (354 ft) and a depth of 1.2 to 1.8 m (4 to 6 ft).

- 1100-3 (The Antifreeze and Degreaser Pit): A shallow, roughly circular depression located approximately 1.6 km (1 mile) north of the 1171 Building on the west side of the Hanford Rail Line. Originally a sand and gravel source for construction activities on the Hanford Site, it was used during the period of 1979 to 1985 as a disposal site for waste construction material, principally roofing and concrete rubble. The pit is approximately 76 m (250 ft) in diameter and 1.8 to 2.4 m (6 to 8 ft) deep. Occasional disposal of waste antifreeze and degreasing solutions from the 1171 Building was suspected, but not documented, at this location.

- 1100-4 (The Antifreeze Tank Site): A former underground storage tank used for waste vehicle antifreeze. This tank was emptied in 1986, cleaned, and removed due to suspected leakage. No evidence of leakage was detected when the tank was removed.

- UN-1100-6 (The Discolored Soil Site): A patch of oily, dark stained soil located in the eastern end of an elongate east-west oriented depression approximately 610 m (2,000 ft) northwest of the 1171 Building on the west side of the Hanford Rail Line. The depression extends over an area of approximately 0.2 hectares (0.4 acres); the actual area of discolored soil covering an area of perhaps 1.8 by 3.1 m (6 by 10 ft). The source of the soil discoloration appears to be the isolated, unauthorized disposal of contents of one or more containers of liquid material to the ground surface. No record exists that identifies the nature or origin of the waste of the material deposited at the site.

• The Horn Rapids Landfill: Located north of Horn Rapids Road near its intersection with Stevens Drive, the Horn Rapids Landfill (HRL) extends over approximately 20 hectares (50 acres) of the 600 Area. Originally a borrow pit for sand and gravel, it was used as a landfill primarily for office and construction waste, asbestos, sewage sludge, fly ash, and reportedly, numerous drums of unidentified organic liquids. Classified documents were also incinerated at a burn cage located at the northern edge of the landfill. from the late 1940's into the 1970's. The landfill is situated in generally flat terrain. Five disposal trenches have been identified at the site through a study of historic aerial photographs, onsite investigations, and geophysical surveys. Surface debris consisting of auto and truck tires, wood, metal shavings, soft drink cans and bottles, and other small pieces of refuse are scattered across the site. A single trench, the western-most of the identified waste disposal trenches, was posted with signs warning that the trench contained asbestos.

• The Ephemeral Pool: A long, narrow, manmade depression located along the western edge of the asphalt-paved 1171 Building parking area. The depression acts as a drainage collection point for precipitation runoff flowing from the parking area surface. Overall dimensions are approximately 6.1 m (20 ft) wide (east-west direction) by 183 to 213 m (600 to 700 ft) in length (north-south direction). The Ephemeral Pool was designed to collect runoff from the parking area and direct it to a central culvert located approximately at the lengthwise mid-point of the depression.

The 1100-EM-2 Operable Unit is located in the southwest corner of the Hanford Site near the north border of the City of Richland, Washington. The main feature is the 1171 Building, a vehicle service maintenance and repair facility constructed in the early 1950's. The main waste sites in 1100-EM-2 are several used oil tanks, steam pad and hoist ram storage tanks, and a hazardous waste staging area. Removal of an antifreeze underground storage tank (UST) from the 1171 Building in 1986 was addressed in the 1100-EM-1 RI/FS.

The 1100-EM-3 Operable Unit is located about 600 meters (1000 feet) northeast of 1100-EM-2. 1100-EM-3 contains approximately 20 permanent structures, some of which date back to 1951, that have been used for maintenance, warehouse, service support, and offices in support of Hanford operations. These buildings form the Hanford 3000 Area. Key waste sites in 1100-EM-3 include several hazardous waste storage and staging areas, a used oil UST, and contaminated soil from a previously removed UST. Four fuel UST's were removed from this area in 1991.

1100-IU-1 is located on the northeastern slope of the Rattlesnake Hills, approximately 24 kilometers (km) (15 miles) from the 1100 Area. The site is a former NIKE missile base consisting of structures which supported missile launch, control, and maintenance functions, as well as living quarters for base personnel, and storage buildings for hazardous substances used in the maintenance of the physical plant and missile operations. All base facilities are abandoned with the exception of the former barracks which are used for the Arid Lands Ecology (ALE) Reserve Headquarters.

III. HIGHLIGHTS OF COMMUNITY PARTICIPATION

DOE, Ecology, and EPA (the Parties) developed a Community Relations Plan (CRP) in April 1990 as part of the overall Hanford Site restoration. The CRP was designed to promote public awareness of the investigations and public involvement in the decision-making process. The CRP summarizes concerns that the Parties are aware of based on community interviews. Since that time, the Parties have held several public meetings and sent out numerous fact sheets in an effort to keep the public informed about Hanford cleanup issues. The CRP was updated in 1993 to enhance public involvement.

The final RI/FS Report and Proposed plan were made available to the public in both the Administrative Record and the Information Repositories maintained at the locations listed below on May 24, 1993:

ADMINISTRATIVE RECORD (Contains all project documents)

U.S. Department of Energy
Richland Field Office
Administrative Record Center
740 Stevens Center
Richland, Washington 99352

EPA Region 10
Superfund Record Center
1200 Sixth Avenue
Park Place Building, 7th Floor
Seattle, Washington 98101

Washington State Department of Ecology
Administrative Record
719 Sleater-Kinney Road SE
Capital Financial Building, Suite 200
Lacey, Washington 98503-1138

INFORMATION REPOSITORIES (Contain limited documentation)

University of Washington
Suzzallo Library
Government Publications Room
Mail Stop FM-25
Seattle, Washington 98195

Gonzaga University
Foley Center
E. 502 Boone
Spokane, Washington 99258

Portland State University
Branford Price Millar Library
Science and Engineering Floor
SW Harrison and Park
P.O. Box 1151
Portland, Oregon 97207

DOE Richland Public Reading Room
Washington State University, Tri-Cities
100 Sprout Road, Room 130
Richland, Washington 99352

The notice of the availability of these documents was published in the *Seattle PI/Times*, the *Spokesman Review-Chronicle*, the *Tri-City Herald*, and the *Oregonian* on May 23, 1993 and again on June 13, 1993. The public comment period was held from May 24, 1993, through July 9, 1993. In addition, a public meeting was held on June 30, 1993. Additional advertisements ran in the *Tri-City Herald* on June 27 and 29, 1993. At the meeting, representatives from DOE and EPA answered questions about the project. A response to the comments received during the public comment period, including those raised during the public meeting, is included in the Responsiveness Summary, which is part of this ROD. This decision document presents the selected remedial action for the 1100 Area at the Hanford Site, Richland, Washington, chosen in accordance with CERCLA, as amended by SARA, and to the extent practicable, the NCP. The decision for this site is based on the Administrative Record.

IV. SCOPE AND ROLE OF RESPONSE ACTION WITHIN SITE STRATEGY

The cleanup actions described in this ROD address all known current and potential risks to human health and the environment from the 1100 Area. This ROD addresses contaminated soils found at 1100-EM-1 and the contaminated groundwater in the vicinity of the Horn Rapids Landfill. In addition, this ROD requires surface and soil cleanups in the other three operable units.

V. SITE CHARACTERISTICS

A. Site Geology and Hydrology

The Hanford Site is located in the Pasco Basin, a topographic and structural basin situated in the northern portion of the Columbia Plateau. The plateau is divided into three general structural subprovinces: the Blue Mountains; the Palouse; and, the Yakima Fold Belt. The Hanford Site is located near the junction of the Yakima Fold Belt and the Palouse subprovinces. A generalized geologic structural map is included as Figure 3.

The 1100 Area is located along the southeastern margin of the Hanford Site, adjacent to the Columbia River. The geologic structure beneath the 1100 Area is similar to much of the rest of the Hanford Site, which consists of three distinct levels of soil formations. The deepest level is a thick series of basalt flows that have been warped and folded, resulting in protrusions that crop out as rock ridges in some places. Layers of silt, gravel, and sand known as the Ringold formation form the middle level. The uppermost level is known as the Hanford formation and consists of gravel and sands deposited by catastrophic floods during glacial retreat. Both confined and unconfined aquifers can be found beneath Hanford. A generalized stratigraphic column is shown in Figure 4.

1. Unconfined Aquifer

The unconfined aquifer below the 1100 Area occurs between the water table and the underlying silt aquitard, approximately 95 to 107 m (310 to 350 ft) above mean sea level (amsl). The aquifer occurs within the lower Hanford formation and the upper portion of the middle Ringold Formation. The thickness of the unconfined aquifer varies; the maximum thickness observed was 13 m (44 ft) near the 1171 Building and the minimum was 5 m (16 ft) near the Horn Rapids Landfill. Outside of the 1100-EM-1 Operable Unit, fewer data are available to map the unconfined aquifer thickness. In general, the thickness appears to increase toward the Columbia River.

Groundwater recharge to the unconfined aquifer below the 1100 Area is primarily from the Yakima River located several miles west and southwest of the site. The river appears to discharge directly to the unconfined aquifer along the Horn Rapids Reach below Horn Rapids Dam. Precipitation and irrigation infiltration, and, potentially, unconfined aquifer flow beneath the Yakima River provide additional recharge to the 1100 Area groundwater. The volume of recharge from infiltrating precipitation is approximately 10 to 40 times less than the recharge from the westward groundwater inflow.

To the east of the 1100 Area, the North Richland well field artificially recharges the unconfined aquifer. Water from the Columbia River is allowed to percolate through the soil at the well field to provide treatment of turbid river water and enhance the well field capacity (see Figure 2 for well field location). This is a major source of recharge to the aquifer and causes groundwater mounding that extends west to the vicinity of the 1171 Building.

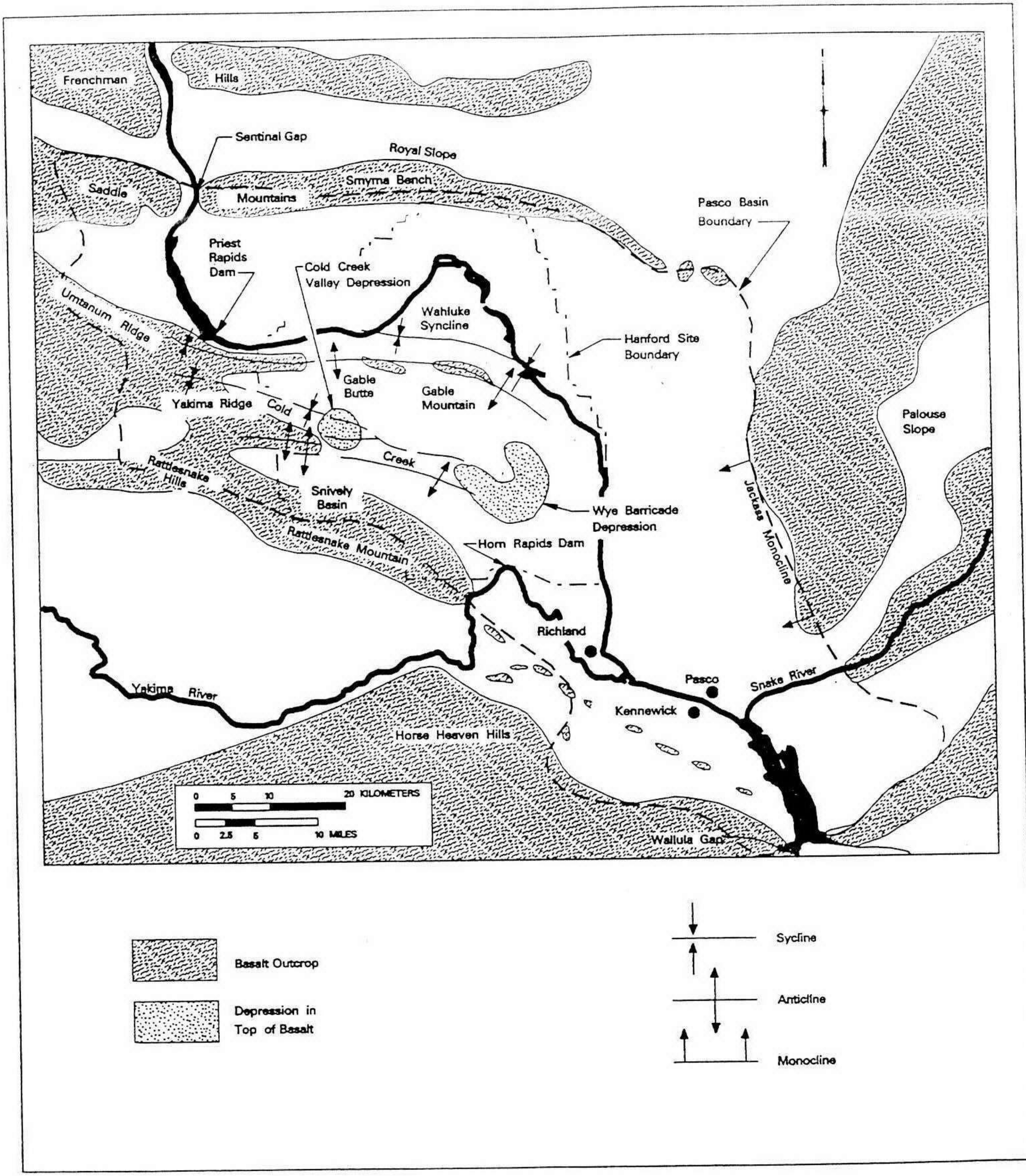


Figure 3. Geologic Structures of the Pasco Basin and the Hanford Site.

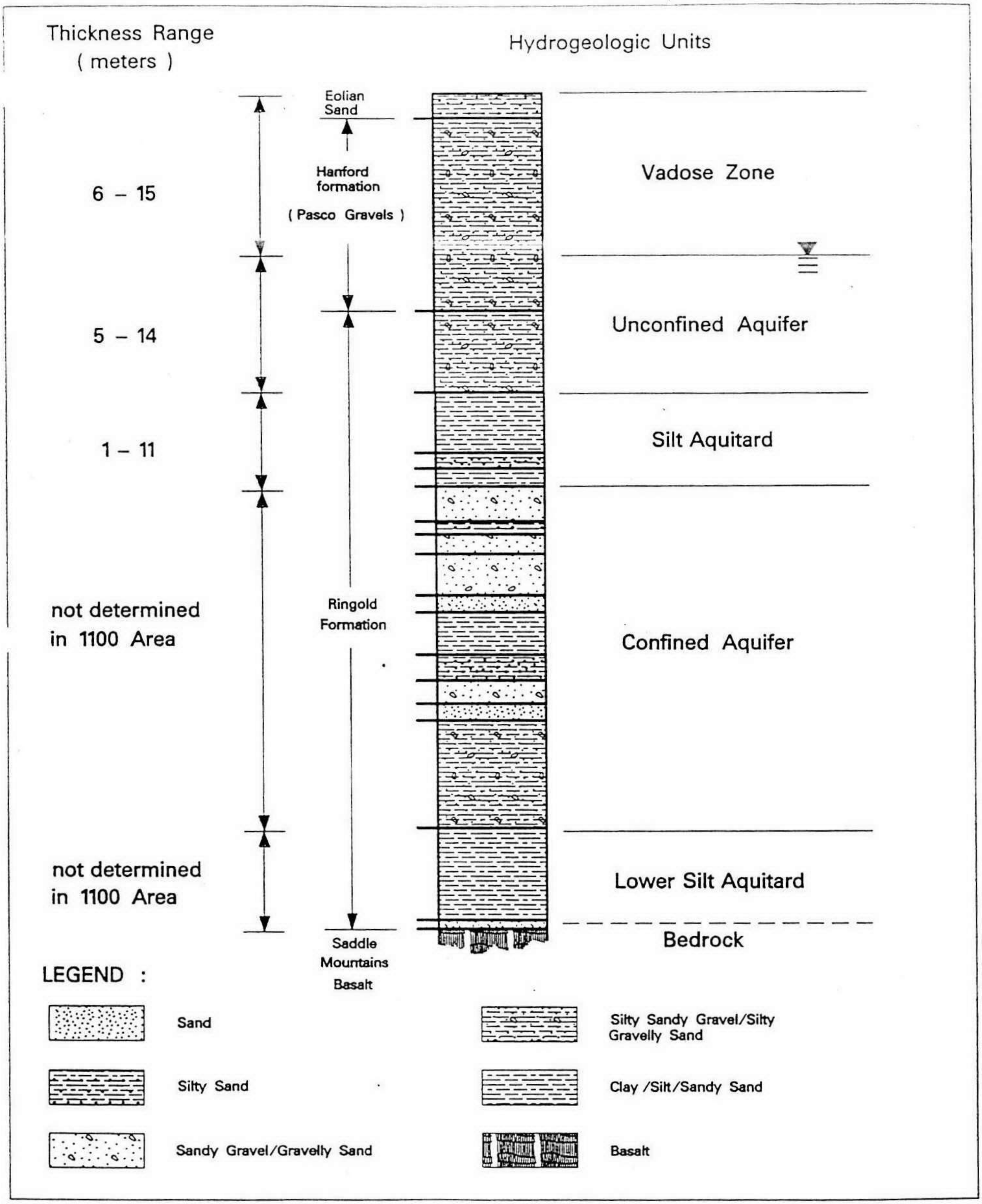


Figure 4 Generalized Hydrostratigraphic Column for the 1100–EM–1 Operable Unit

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However, because the well field is recharged intermittently, the mound can dissipate between periods of recharge. Monthly totals for recharge at the well field during 1988 and 1989 ranged from about 75,000,000 L (20,000,000 gal) to 1,500,000,000 L (400,000,000 gal).

2. Confined Aquifer

A silt aquitard was identified during drilling throughout the 1100-EM-1 Operable Unit. The aquitard was encountered within the interval from 91 to 102 m (299 to 333 ft) amsl. Wells drilled to elevations lower than 91 m (299 ft) amsl invariably intercepted the aquitard. There is, however, uncertainty regarding the continuity of this layer. A possibility exists for the aquitard to be discontinuous due to erosion that may have occurred before the overlying sediments were deposited.

The upper confined aquifer occurs immediately below the silt aquitard. Information on this aquifer is limited, as the 1100-EM-1 RI hydrogeological investigation focused primarily on the vadose zone and unconfined aquifer. The available information does not show evidence that the confined aquifer is contaminated.

The groundwater potentials measured in 1100 Area confined aquifer wells indicate that flow is apparently toward the east. There is also flow upward into the silt aquitard that occurs above the confined aquifer. It is unknown if North Richland well field operations have significant affects on the flow observed in this aquifer, although minor fluctuations observed in water levels measured in one well indicate that at least some minor effect is likely.

The sediments encountered in the confined aquifer ranged from silty sand to sandy gravel of the middle Ringold Formation. Rising head slug tests yielded hydraulic conductivity estimates of .034 m/d (1.0 ft/d) and 0.086 m/d (0.30 ft/d), respectively, indicating that at least in these two locations the hydraulic conductivity is generally lower than in the unconfined aquifer (see Table 1).

The upper confined aquifer was identified at the HRL, and to the south nearer the 1171 Building. The vertical thickness of the upper confined aquifer may vary from a few meters up to 10 m (30 ft), depending on the continuity of silt strata in the middle Ringold unit.

Table 1. Measured and Estimated Saturated Zone Hydraulic Properties

Hydrogeologic Unit	Horizontal Hydraulic Conductivity	Vertical Hydraulic Conductivity	Storage Coefficient	Porosity (effective)
	(m/d)	(m/d)		
Unconfined Aquifer				
Hanford Formation (near HRL)	400 - 520	40 - 50*	.02 - .37*	.20 - .33*
Hanford Formation (near 300 Area)	3350 - 15000	330 - 1500*	.02 - .37*	.20 - .33*
Ringold Formation	10 - 72	2 - 5	.02 - .37	.11 - .30*
Silt Aquitard	.001 - .03	.0001 - .003*		.20 - .33*
Confined Aquifer	10 - 72	2 - 5		.11 - .30*

* based on general reported values at the Hanford Site or extrapolated from nearest available value

B. Nature and extent of Contamination

Investigative Approach

The investigations in the 1100-EM-1 Operable Unit were conducted in a two-phase approach, with tasks proceeding methodically. The investigative methodology was to start off with a radiation survey of all of the sites, then do surface geophysics (e.g. electromagnetic induction and ground-penetrating radar). Next, a soil gas survey using temporary probes was performed and surface samples were taken. All of the information gathered to date was used to site vadose zone borings and groundwater wells. Other tasks in phase one were the determination of soil and groundwater background values and air monitoring during intrusive investigations. The information gathered from this first phase was evaluated to determine the tasks for the second phase. The tasks in the second phase were similar to those in the first, although they were much more focused.

For the other three operable units, the investigative approach was quite different, and much more streamlined. In the fall of 1992, it was determined that 1100-EM-2, 1100-EM-3 and 1100-IU-1 were candidates for an accelerated evaluation that could enable all of the 1100

Area operable units to be addressed simultaneously. A limited field investigation/focused feasibility study (LFI/FFS) was undertaken for those three operable units.

The results of the 1100 Area investigations are described in the following paragraphs.

1. 1100-EM-1 Soils

Battery Acid Pit

A geophysical survey was conducted over the area where the pit had been to find the exact location of the pit and locate soil gas probes and a vadose zone boring. The pit was located, along with other buried objects including a water line and some wires. Five temporary soil-gas probes were installed at the Battery Acid Pit as part of the first phase. No contamination was detected in the soil-gas samples. A single boring was made at the Battery Acid Pit. This borehole yielded one sample from the surface and seven from the subsurface. Substances identified (i.e., detected above background) in surface soil samples are: calcium, copper, lead, magnesium, mercury, nickel, sodium, and zinc. Substances identified in subsurface samples are: arsenic, copper, lead, mercury, potassium, sodium, vanadium, and zinc. Maximum values of all soil analytes were compared with background to identify contaminants. These were further screened to remove essential micronutrients (i.e., at the concentrations measured, aluminum, calcium, iron, magnesium, potassium, and sodium are nontoxic and do not pose a human health or an environmental threat). The remaining soil contaminants are considered to be of potential concern and were evaluated further in the risk assessment. These soil contaminants, and their maximum concentrations, are presented in Table 2. No additional work was performed during the second phase.

Paint and Solvent Pit

The geophysical survey was conducted over the floor of the pit. Rubble and other construction debris were found. Sixty-two temporary soil-gas probes were installed, sampled, and analyzed during phase one. One area of relatively high readings of tetrachloroethene (PCE) was found in the southwest corner of the site close to the end of a service road which extends back toward a railroad storage yard located immediately north of the Paint and Solvent Pit site. Concentration values peaked at 727 μg/L PCE with values steeply dropping in all directions away from the high. Areal distribution of the positive soil-gas readings suggested the potential for an isolated, shallow accumulation or small surface spill of solvent within the pit. No other volatile contaminants were detected during the soil-gas survey.

Four boreholes drilled at this site yielded 4 surface samples and 29 subsurface soil samples. One of these boreholes was drilled in the location of the high PCE reading described above. In addition, soil samples were obtained at 20 surface locations within the 1100-2, Paint and Solvent Pit. Substances identified in surface soil samples are: calcium, chromium, copper, lead, potassium, sodium, thallium, chlorobenzene, tetrachloroethene, trichloroethene,

Table 2. Summary of 1100-EM-1 Operable Unit Soil Contaminants and Maximum Contaminant Concentrations. (sheet 1 of 2)

Contaminant	Battery Acid Pit (1100-1) (mg/kg)	Paint and Solvent Pit (1100-2) (mg/kg)	Antifreeze and Degreaser Pit (1100-3) (mg/kg)	Antifreeze Tank Site (1100-4) (mg/kg)	Discolored Soil Site (UN-1100-6) (mg/kg)	Horn Rapids Landfill (mg/kg)	Ephemeral Pool (mg/kg)
Antimony	--	--	--	--	--	15.6	--
Arsenic	3.2	--	--	5.8	--	6.6	--
Barium	--	--	--	--	--	1,320	--
Beryllium	--	--	--	0.93	--	1.3	--
Cadmium	--	--	--	--	--	2.4	--
Chromium	--	16.8	14	--	--	1,250	--
Cobalt	--	--	17.8	--	--	42.5	--
Copper	37.9	24.4	31.7	19.8	--	1,280	--
Cyanide	--	--	--	--	--	0.56	--
Lead	266	94.6	26.4	5.7	22.1	854	54.2
Manganese	--	366	436	--	--	501	--
Mercury	0.39	--	--	--	--	1.3	--
Nickel	20.9	--	--	--	--	557	--
Selenium	--	--	--	--	--	0.97	--
Silver	--	--	--	2	--	7.7	--
Thallium	--	0.48	0.4	0.48	--	3.1	--
Vanadium	118	--	--	--	--	101	--
Zinc	100	56.6	60	63.8	111	3,160	67.5

Table 2. Summary of 1100-EM-1 Operable Unit Soil Contaminants and Maximum Contaminant Concentrations. (continued)

Contaminant	Battery Acid Pit (1100-1) (mg/kg)	Paint and Solvent Pit (1100-2) (mg/kg)	Antifreeze and Degreaser Pit (1100-3) (mg/kg)	Antifreeze Tank Site (1100-4) (mg/kg)	Discolored Soil Site (UN-1100-6) (mg/kg)	Horn Rapids Landfill (mg/kg)	Ephemeral Pool (mg/kg)
BEHP	--	--	--	--	25,000	--	--
Beta-HCH	--	--	--	--	--	0.094	--
Chlordane	--	--	--	--	1.86	--	2.8
Chlorobenzene	--	0.006	--	--	--	--	--
DDT	--	0.16	--	--	0.17	1.98	--
Endosulfan II	--	--	--	--	--	0.11	0.16
Endrin	--	--	--	--	--	0.42	0.039
Heptachlor	--	--	--	--	0.065	0.02	0.029
2-Hexanone	--	--	--	--	0.053	--	--
Naphthalene	--	--	--	--	--	8.2	--
PCB's	--	--	--	--	--	100	42
Tetrachloroethene	--	0.035	--	--	--	0.006	--
Trichloroethene	--	0.006	--	--	--	--	--
1,1,1-Trichloroethane	--	--	--	--	0.035	--	--
-- Indicates not a contaminant at this unit							

1,1-dichloroethene, and xylene. Contaminants identified in subsurface samples are: calcium, copper, lead, magnesium, manganese, potassium, sodium, zinc, 4,4'-DDE, 4,4'-DDT, and tetrachloroethene (see Table 2). No additional work was performed during the second phase.

Antifreeze and Degreaser Pit

The geophysical survey was conducted over the floor of the pit. Rubble and other construction debris were found. Forty-three soil-gas samples were collected from temporary probes in the Antifreeze and Degreaser Pit. No contaminants were detected during the soil-gas investigation. Twenty-three surface samples were collected and twenty-four subsurface samples were obtained from four boreholes at the 1100-3, Antifreeze and Degreaser Pit. Substances identified in surface soil samples are: aluminum, calcium, chromium, copper, lead, sodium, and thallium. Substances identified in subsurface samples collected during the Phase I investigation are: aluminum, calcium, cobalt, copper, iron, magnesium, manganese, sodium, and zinc (see Table 2). No additional work was performed during the second phase.

Antifreeze Tank Site

In November 1989, a hole was cut through the concrete floor of stall 89 inside the 1171 Building to allow sampling of the waste site. Thirteen vadose zone samples were collected and analyzed for the full suite of chemical analyses including ethylene glycol. Only a single sample detected ethylene glycol, at a concentration of 2.6 parts per million (ppm). Other than this single exception, only inorganic contaminants were detected at this site. Substances identified in subsurface samples are: aluminum, arsenic, beryllium, calcium, copper, lead, potassium, silver, sodium, thallium, zinc,and ethylene glycol (see Table 2). No additional work was performed during the second phase.

Discolored Soil Site

Fifteen surface samples were obtained from this site during the first phase. Substances identified in surface soil samples are: lead, potassium, zinc, alpha-chlordane, gamma-chlordane, 4,4'-DDE, bis(2-ethylhexyl)phthalate, heptachlor, 2-hexanone, di-n-octyl phthalate, and 1,1,1-trichloroethane (see Table 2).

Fourteen temporary soil-gas probes were installed at the Discolored Soil Site to depths ranging between 0.46 and 1.22 m (1.5 and 4 ft) during the Phase II investigation. The purpose was to investigate the possibility of a vadose zone source for contaminants identified during surface soil sampling/analysis. Soil gas samples did not identify any contaminants. No other work was performed during the second phase.

Ephemeral Pool

Two surface samples taken from the soil within the Ephemeral Pool area. Substances identified in surface soil samples are: lead, zinc, Aroclor-1260, alpha-chlordane, gamma-chlordane, Endosulfan II, Endrin, and heptachlor (see Table 2). Six surface samples were obtained during Phase II to delineate the lateral extent of organic contamination at the Ephemeral Pool. The soil samples collected during the Phase II RI were submitted for PCB and pesticide analyses. Laboratory results confirm the presence of alpha and gamma chlordane in concentrations of 210 to 1100 μg/kg and 330 to 1700 μg/kg, respectively. Positive results for PCB's (Aroclor 1260) were obtained from two of the seven samples with concentrations of 11,000 and 42,000 μg/kg. Contaminants identified in surface soil samples collected during Phase II are: Chlordane (alpha and gamma), Endosulfan II, Endrin, and PCB's (total).

<u>Horn Rapids Landfill (HRL)</u>

The purpose of the first phase geophysical investigation was to obtain information regarding waste materials buried at the site, to locate waste disposal structures (pits and trenches), to identify any underground utilities crossing the site, and to identify any other waste disposal-related features existing within the landfill. Outside of five identified waste disposal trenches, no other major waste accumulations were detected, although the entire surface of the subunit is littered with miscellaneous debris. Soil-gas studies were performed at the HRL and in surrounding areas to assist in siting permanent groundwater monitoring wells and to survey the vadose zone for a possible contaminant source contributing to groundwater contamination. Two hundred and eleven temporary soil-gas extraction points were installed in the landfill area. Trichloroethene (TCE); 1,1,1-trichloroethane (TCA); and PCE were found within the HRL. Results of this study were used to determine the siting of subsequent groundwater monitoring wells. A total of 36 permanent soil-gas extraction points were installed within the limits of the HRL. TCE was detected at 17 locations, with concentrations ranging from 3 to 233 parts per billion by volume (ppbv).

After the geophysical and soil-gas surveys were done, 55 surface soil samples were taken. Substances identified in surface soil samples are: aluminum, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, cyanide, iron, lead, magnesium, mercury, nickel, potassium, silver, sodium, thallium, zinc, Aroclor-1248, Aroclor-1254, Alpha-Chlordane, 4,4'-DDD, 4,4'-DDE, 4,4'-DDT, Heptachlor, 2-methylnaphthalene, naphthalene, and tetrachloroethene (see Table 2).

Fifty-five subsurface samples were taken from fourteen boreholes drilled in the Horn Rapids Landfill area. Substances identified in subsurface soil samples are: aluminum, antimony, arsenic, barium, beryllium, cadmium, calcium, chromium, cobalt, copper, cyanide, iron, lead, magnesium, mercury, nickel, potassium, silver, sodium, thallium, zinc, and Aroclor-1248.

During the second phase investigation, additional soil-gas surveys, geophysical surveys, surface soil sampling, and subsurface soil sampling were performed. During the second-phase soil-gas survey, a total of 53 additional, temporary, sampling probes were installed and analyzed to delineate the TCE plume previously identified in the vicinity of HRL. TCE was detected at concentrations from 2 to 255 parts per billion by volume (ppbv) in 36 of the 53 probes. The highest TCE concentrations were obtained just outside the disturbed portions at the eastern limits of HRL. Results obtained from this stage of soil-gas monitoring were used in the siting of additional groundwater monitoring wells installed during the Phase II investigation.

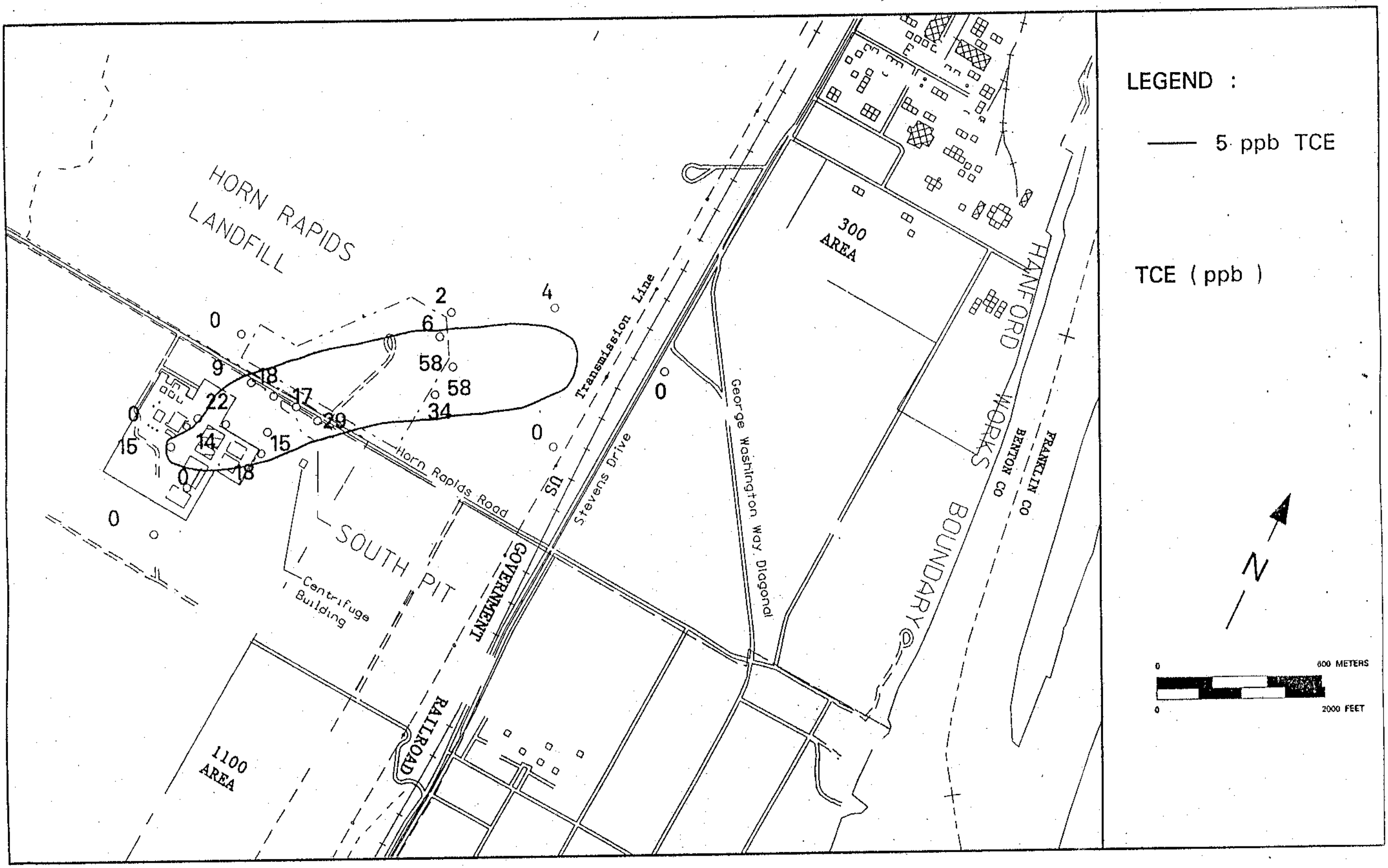
The additional geophysical survey was performed to further delineate disposal trench boundaries identified during the first geophysical surveys of the site and to search for an accumulation of drums containing organic solvents said to have been buried in the HRL. Areas identified by the geophysics that might represent an accumulation of drums were investigated with test pits (described below).

Eight surface samples were taken to identify the areal extent of PCB contamination in the HRL. Fifteen samples were taken from the surface to further characterize 2 surface depressions in the HRL. Thirteen subsurface samples were taken from the test pits dug as a result of the geophysical survey. Substances identified during this phase that were not detected during the first phase include Endosulfan II and Endrin in surface samples and manganese and Dieldrin in subsurface samples. Also found during excavation of the test pits were various types of debris (automotive, construction, etc.) and two small deposits of chemicals. One (white crystalline powder) was identified as sodium bisulfate and the other (bright purple-stained soil) was identified as potassium permanganate.

2. Groundwater

During the first phase of the 1100-EM-1 Operable Unit investigation, seventeen new wells were drilled in the 1100-EM-1 operable unit between August 1989 and January 1990. During phase two, seven additional wells were drilled between January and June 1991. With the addition of existing wells, 30 to 35 wells were sampled each quarter from January 1990 through October 1992, for a total of 11 rounds of sampling. Initially, the scope of the groundwater investigation was very broad and so the first two rounds of samples were analyzed for compounds on the Target Analyte List (TAL), Target Compound List (TCL), as well as RCRA and primary and secondary drinking water parameters. After the first two rounds, the scope was adjusted to reflect refinements in the conceptual site model.

Trichloroethylene- (TCE-) contaminated groundwater was found both upgradient and downgradient of the Landfill. The TCE plume is approximately 1.6 kilometers (1 mile) long and 0.3 kilometer (0.2 mile) wide and is moving in a northeasterly direction. Figure 5 shows the approximate outline of the TCE plume as of March 1992. In addition, the groundwater monitoring network for the Landfill has detected nitrates and Technetium-99 (a radionuclide). A review of all available information indicates that contamination has moved onto the Site via the groundwater. An adjacent facility is investigating soil and groundwater contamination as an independent action in accordance with the Washington State Model Toxics Control Act (MTCA).



TCE Data and Approximate Plume Extent, March 1992.

Figure 5

Maximum values of all groundwater analytes were compared with background values to identify contaminants. These groundwater contaminants, and their maximum concentrations, are presented in Table 3. These were further screened to remove essential micronutrients. At the concentrations measured, aluminum, barium, calcium, iron, magnesium, potassium, sodium, and zinc are nontoxic and do not pose a human health or an environmental threat. The remaining contaminants are considered to be of potential concern and were evaluated further in the risk assessment.

3. 1100-EM-2, 1100-EM-3, and 1100-IU-1 Soils and Debris

Between October 1992 and January 1993, a limited field investigation was performed at 1100-EM-2, 1100-EM-3 and 1100-IU-1. Initially, the Hanford waste information data system was reviewed for data on waste types, handling practices, or known soil or groundwater contamination was reviewed. This identified 64 sites. Then, historical information including aerial photographs and as-built construction drawings were reviewed. All of the sites were inspected and, whenever possible, knowledgeable personnel were interviewed. During this process, an additional 18 sites were identified, bringing the total to 82. At this point, pertinent regulatory aspects [*e.g.*, underground storage tanks (UST's) regulated under the state UST program] and previous characterizations of sites, were reviewed for indication of potential releases and spills of contaminants to the environment. This resulted in the identification of 32 sites that are currently, or are a candidate for, management under other regulatory programs. Of the remaining sites, 43 are considered to be likely or potential sites of releases or spills, and 7 are sites of known releases or spills.

Once the environmental and regulatory information for each site was evaluated, each site was placed in one of four categories, and the last three categories were evaluated for cleanup:

- Already remediated or currently under regulation by the State or EPA under a statute other than the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) or the Model Toxics Control Act (MTCA). (20 sites)

- Pending or a candidate for regulation by the State or EPA under a statute other than CERCLA or MTCA. (12 sites)

- Not a candidate for regulation under another statute and is the site of a <u>likely</u> or <u>potential</u> release or spill of contaminants to the environment. (43 sites)

- Not a candidate for regulation under another statute and is the site of a <u>known</u> release or spill of contaminants to the environment. (7 sites)

The categories of sites evaluated for cleanup are further broken down by waste or site type and are summarized below:

Table 3. Summary of 1100-EM-1 Operable Unit Groundwater Contaminants and Maximum Contaminant Concentrations. (sheet 1 of 2)

Analyte (units)	MCL Level	Background	Maximum Concentration Observed
Aluminum (ppb)	50-200	152	1350
Barium (ppb)	1000	60.5	132
Calcium (ppb)	NA	74600	197000
Chromium (ppb)	100	7.8	57.5
Copper (ppb)	1300	5.22	71.9
Iron (ppb)	300	820	2050
Lead (ppb)	50	13.7	25.3
Magnesium (ppb)	NA	20200	42100
Manganese (ppb)	NA	390	352
Nickel (ppb)	100 (proposed)	15	140
Silver (ppb)	50	4	11.7
Potassium (ppb)	NA	7140	13900
Sodium (ppb)	NA	29500	56900
Zinc (ppb)	NA	8.3	223
Ammonia (ppm)	NA	0.15	0.87
Fluoride (ppm)	4	0.5	3.7
Chloride (ppm)	250	22.1	110
Phosphate (as P) (ppm)	NA	1	1.9
Sulfate (ppm)	255	42.5	89.6
Nitrate (as N) (ppm)	10	12.3	61
Methylene Chloride (ppb)	5 (proposed)	1	13
Acetone (ppb)	NA	10	31
Chloroform (ppb)	100	1	5
1,1,1-Trichloroethane (ppb)	200	1.2	3
Trichloroethene (ppb)	5	1	110

Table 3. Summary of 1100-EM-1 Operable Unit Groundwater Contaminants and Maximum Contaminant Concentrations. (continued)

Analyte (units)	MCL Level	Background	Maximum Concentration Observed
Tetrachloroethene (ppb)	5	1	4
Toluene (ppb)	2000 (proposed)	1	2
Diethylphthalate (ppb)	NA	10	34
Gross Alpha (pCi/L)	15	8.4	12.2
Gross Beta (pCi/L)	50	18	95.4
Radium (pCi/L)	20	1.7	2.36

Site	Number	Approximate Volume (Total)
Underground Storage Tanks	21	380 Cubic Yards
Soil Sites with Metals	6	440 Cubic Yards
Soil Sites with Organics	12	940 Cubic Yards
Spills	5	125 Cubic Yards
Septic Systems	6	3,600 Cubic Yards
Debris Sites	2	10 Cubic Yards
PCB Transformers/Pads	6	410 Cubic Yards
Others	2	No Estimate
Landfills	2	Approximately 5 Acres

Contaminants of potential concern that are evaluated in the risk assessment are: 1,1,1-Trichloroethane, PCBs, Carbon Tetrachloride, Aniline, Furfuryl Alcohol, Dimethylhydrazine, Acetone, Chromium Trioxide, Chromium-containing Paints, Sodium Dichromate, Trichloroethylene (TCE), Benzene, Toluene, Ethylbenzene, Xylenes, Lead, Tetrachloroethene (PCE), TPH (gasoline), TPH (diesel), and PAH's.

VI. SUMMARY OF SITE RISKS

The approach for evaluation of site risks for the 1100-EM-1 consisted of evaluating the results of the remedial investigations to develop an initial list of Contaminants of Potential Concern (COPC) (Table 4). The COPC list was further evaluated and screened in accordance with the Hanford Site Baseline Risk Assessment Methodology (HSBRAM) and in consultation with EPA Region 10. HSBRAM was developed by DOE, in consultation with EPA and Ecolgy. HSBRAM is based on EPA's *Risk Assessment Guidance for Superfund* (RAGS) and other EPA guidance (both national and Region 10). HSBRAM was developed to provide direction on flexible, ambiguous, or undefined aspects of the various guidances, while ensuring that Hanford Site risk assessments remain consistant with current regulations and guidance. A Baseline Residential Scenario Risk Assessment (BRSRA) and a Baseline Industrial Scenario Risk Assessment (BISRA) were conducted in accordance with the HSBRAM. In addition, potential ecological risks were evaluated. The results of the human health and ecological risks are discussed below.

A. Human Health Risks

Adverse effects resulting from exposure to chemical contaminants are identified as either carcinogenic (i.e. causing development of cancer in one or more tissues or organ systems) or non-carcinogenic (i.e., direct effects on organ systems, reproductive and developmental effects). In the BISRA, risks for current and future industrial use have been evaluated. In the BRSRA, future residential land use was evaluated. The human risk receptors included

Table 4. Summary of Contaminants of Potential Concern for the 1100-EM-1 Operable Unit.

Contaminant	1100-1	1100-2	1100-3	1100-4	Discolored Soil Site UN-1100-6	Horn Rapids Landfill	Ephemeral Pool	Ground-water
Antimony						X		
Arsenic	X			X		X		
Barium						X		
Beryllium				X		X		
Chromium		X	X			X		
Copper						X		
Lead[a]						--[a]		
Manganese		X	X			X		
Nickel	X					X		
Thallium						X		
Vanadium	X					X		
Zinc						X		
BEHP					X			
Beta-HCH						X		
Chlordane					X		X	
DDT						X		
Heptachlor					X	X	X	
PCB's						X	X	
Nitrate								X
TCE								X

[a]Contaminant of interest

on-site long- and short-term workers, and hypothetical future on-site residents. Exposure conditions for these receptors were assumed to correspond to a wide range of activities including residential, recreational and industrial.

1. Chemicals of Concern

Data collected during the RI were used to identify chemicals present at 1100-EM-1. The previous section of this ROD presents sampling results by media. All chemicals were included in the assessment unless: a) it was not detected in the media sampled; b) toxicity reference values (i.e. reference dose [RfD] or cancer slope factors [SF's]) have not been developed for the chemical; or c) the chemical was identified as an essential nutrient.

Eight COC's were identified based on BISRA and BRSRA reasonable maximum exposure (RME) scenarios. In this case, COC's are defined as those with potential exposures presenting a carcinogenic risk greater than 1×10^{-6} and a non-carcinogenic hazard index greater than a value of one. Based on average exposures, the number of COC's would be reduced to four.

Two of the COC's are known carcinogens (arsenic and chromium [hexavalent only]); five are probable human carcinogens (beryllium, BEHP, chlordane, PCB's and trichloroethene). The remaining COC is a non-carcinogen (nitrate).

2. Exposure Assessment

a. Exposed Populations: Exposure pathways were evaluated for three receptors: future residents, current and future onsite workers. The exposure pathways, exposure point concentrations for the residential scenario are presented in Table 5, and the exposure pathways, exposure point concentrations and for the industrial scenario are presented in Table 6.

b. Exposure Point Concentrations: Exposure point concentrations, including average and maximums, were derived for each medium of exposure (soil ingestion, inhalation, dermal contact, fish ingestion, garden produce, groundwater ingestion and groundwater inhalation [volatiles]). Generally a reasonable maximum exposure concentration (RME based on a 95 percent upper confidence limit) is presented in Tables 7 and 8. Where other values were used, the tables are footnoted.

c. Chemical Intake by Exposure Pathway: Chemical intakes (mg/kg/day) were estimated for each exposure pathway using exposure point concentrations and other exposure parameters, such as soil and water ingestion rates, body weights, exposure frequencies and durations. Pathway specific equations from both EPA and the HSBRAM were used to estimate chemical uptakes.

3. Toxicity Assessment

Table 5. Summary of Residential Scenario Intakes Based on Maximum Contaminant Concentrations for the Soil Ingestion, Fugitive Dust Inhalation, and Dermal Exposure Pathways at Specific 1100-EM-1 Operable Subunits.

Contaminant	Pathway					
	Soil Ingestion (mg/kg-d)		Fugitive Dust Inhalation (mg/kg-d)		Dermal Exposure (mg/kg-d)	
	Noncarcinogenic	Carcinogenic	Noncarcinogenic	Carcinogenic	Noncarcinogenic	Carcinogenic
1100-2						
Tetrachloroethene	1.3×10^{-7}	5.6×10^{-8}	--[c]	1.4×10^{-10}	1.7×10^{-7}	7.2×10^{-8}
1100-3						
Arsenic	1.3×10^{-5}	5.4×10^{-6}	--[c]	3.2×10^{-9}[a]	2.7×10^{-7}	1.1×10^{-7}
Chromium	5.2×10^{-5}	--[b]	--[c]	4.4×10^{-8}	1.1×10^{-6}	--[b]
Lead	--[c]	--[d]	--[c]	--[d]	--[c]	--[d]
UN-1100-6						
BEHP	9.3×10^{-2}	4.0×10^{-2}	--[c]	5.3×10^{-5}	1.1×10^{-2}	4.7×10^{-3}
Chlordane	6.9×10^{-6}	2.9×10^{-6}	--[c]	4.0×10^{-9}	8.8×10^{-6}	3.8×10^{-6}
Ephemeral Pool						
Chlordane	1.0×10^{-5}	4.5×10^{-6}	--[c]	1.6×10^{-8}	1.3×10^{-5}	5.7×10^{-6}
PCBs	--[c]	6.6×10^{-5}	--[c]	2.4×10^{-7}	--[c]	8.6×10^{-5}
Horn Rapids Landfill						
Arsenic	2.4×10^{-5}	1.0×10^{-5}	--[c]	2.6×10^{-8}[a]	5.2×10^{-7}	2.2×10^{-7}
Beryllium	4.8×10^{-6}	2.1×10^{-6}	--[c]	1.7×10^{-8}	1.0×10^{-7}	4.4×10^{-8}
Chromium	4.6×10^{-3}	--[b]	--[c]	1.7×10^{-5}	9.9×10^{-5}	--[b]
Lead	--[c]	--[d]	--[c]	--[d]	--[c]	--[d]
PCBs	--[c]	1.6×10^{-4}	--[c]	1.3×10^{-6}	--[c]	2.1×10^{-4}
Tetrachloroethene	2.2×10^{-8}	9.6×10^{-9}	--[c]	8.0×10^{-11}	2.8×10^{-8}	1.2×10^{-8}

[a]Intakes adjusted for 30% absorption of inhaled arsenic
[b]Not considered carcinogenic by this route of exposure or pathway
[c]RfD not available to evaluate intake for this pathway.
[d]SF not available to evaluate intake for this pathway.
-- Indicates not applicable

Table 6. Summary of Contaminant Intakes for Homegrown Vegetables in the Garden Pathway at Specific 1100-EM-1 Operable Subunits Based on the Maximum Contaminant Concentrations in Soil.

	Leafy (lettuce)[a] (mg/kg-d)		Root (carrots)[b] (mg/kg-d)		Garden Fruits (tomatoes)[c] (mg/kg-d)		Potatoes[d] (mg/kg-d)		Total Contaminant Intake (mg/kg-d)	
	Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic	Non-Carcinogenic	Carcinogenic
1100-3										
Arsenic	2.0×10^{-8}	--[e]	8.2×10^{-7}	--[e]	2.0×10^{-7}	-[e]	2.4×10^{-7}	--[e]	3.3×10^{-6}	--[e]
Chromium	4.2×10^{-6}	--[e]	4.3×10^{-6}	--[e]	1.7×10^{-6}	-[e]	1.0×10^{-4}	--[e]	2.0×10^{-4}	--[e]
Lead	--[f]	--[g]	--[f]	--[g]	--[f]	--[g]	--[f]	--[g]	--[f]	--[g]
Discolored Soil Site (UN-1100-6)										
BEHP	1.4×10^{-1}	6.2×10^{-2}	1.1×10^{-1}	4.7×10^{-2}	1.5×10^{-2}	6.5×10^{-3}	6.4×10^{-2}	2.6×10^{-2}	3.3×10^{-1}	1.4×10^{-1}
Chlordane	5.6×10^{-7}	2.4×10^{-7}	4.6×10^{-6}	2.0×10^{-6}	1.2×10^{-6}	5.1×10^{-8}	7.1×10^{-6}	3.0×10^{-6}	1.2×10^{-4}	5.5×10^{-6}
Ephemeral Pool										
Chlordane	8.4×10^{-7}	3.6×10^{-7}	7.0×10^{-6}	3.0×10^{-6}	1.8×10^{-6}	7.8×10^{-8}	1.0×10^{-4}	4.5×10^{-6}	1.9×10^{-4}	8.3×10^{-6}
PCBs	--[f]	1.0×10^{-4}	--[f]	7.8×10^{-6}	--[f]	1.1×10^{-6}	--[f]	4.5×10^{-6}	--[f]	2.3×10^{-4}
Horn Rapids Landfill										
Arsenic	4.0×10^{-8}	--[e]	1.6×10^{-6}	--[e]	3.9×10^{-7}	--[e]	5.1×10^{-7}	--[e]	6.4×10^{-6}	--[e]
Beryllium	8.4×10^{-8}	3.6×10^{-8}	4.1×10^{-8}	1.8×10^{-8}	1.6×10^{-8}	6.9×10^{-7}	9.9×10^{-8}	4.2×10^{-8}	2.4×10^{-6}	1.0×10^{-6}
Chromium	3.8×10^{-3}	--[e]	3.8×10^{-3}	--[e]	1.5×10^{-3}	--[e]	9.6×10^{-3}	--[e]	1.8×10^{-2}	--[e]
Lead	1.0×10^{-4}	4.4×10^{-6}	3.1×10^{-6}	1.4×10^{-6}	5.1×10^{-6}	2.2×10^{-6}	8.7×10^{-6}	3.6×10^{-6}	2.6×10^{-4}	1.2×10^{-4}
PCB's	--[f]	2.5×10^{-4}	--[f]	1.9×10^{-4}	--[f]	2.6×10^{-6}	--[f]	1.1×10^{-4}	--[f]	5.8×10^{-4}

[a] Assumes intake of 1.1 g/d dry weight
[b] Assumes intake of .88 g/d dry weight
[c] Assumes intake of 2.2 g/d dry weight
[d] Assumes intake of 9.1 g/d dry weight
[e] Not considered carcinogenic by this route of exposure or pathway
[f] RfD not available to evaluate intake for this pathway.
[g] SF not available to evaluate intake for this pathway.
-- Indicates not applicable

Table 7. Comparison of the Baseline Industrial Incremental Cancer Risk Assessment Results using the Maximum Contaminant Concentrations and 95-percent UCL for the Discolored Soil Site (UN-1100-6), the Ephemeral Pool, and the Horn Rapids Landfill.

Subunit	Pathway	95-percent UCL Pathway Totals	Maximum Concentration Pathway Totals	95-percent UCL Subunit Totals	Maximum Concentration Subunit Totals
		ICR	ICR	ICR	ICR
Discolored Soil Site (UN-1100-6)	Soil Ingestion	2×10^{-5}	3×10^{-5}		
	Fugitive Dust Inhalation	2×10^{-7}	4×10^{-7}		
	Dermal Exposure	2×10^{-6}	3×10^{-6}		
				2×10^{-5}	3×10^{-5}
Ephemeral Pool	Soil Ingestion	9×10^{-6}	3×10^{-5}		
	Fugitive Dust Inhalation	3×10^{-7}	8×10^{-7}		
	Dermal Exposure	1×10^{-5}	3×10^{-5}		
				2×10^{-5}	6×10^{-5}
Horn Rapids Landfill	Soil Ingestion	2×10^{-5}	6×10^{-5}		
	Fugitive Dust Inhalation	2×10^{-5}	3×10^{-4}		
	Dermal Exposure	3×10^{-5}	8×10^{-5}		
				7×10^{-5}	4×10^{-4}

Table 8. Comparison of the Baseline Residential Scenario Risk Assessment Results using the Maximum Contaminant Concentrations and 95-percent UCL for the Discolored Soil Site (UN-1100-6), the Ephemeral Pool, and the Horn Rapids Landfill.

Subunit	Pathway	95-percent UCL Pathway Totals		Maximum Concentration Pathway Totals		95-percent UCL Subunit Totals		Maximum Concentration Subunit Totals	
		HI[a]	ICR[b]	HI[a]	ICR[b]	HI[a]	ICR[b]	HI[a]	ICR[b]
Discolored Soil Site (UN-1100-6)	Soil Ingestion	3.0	4×10^{-4}	4.7	6×10^{-4}	18	2×10^{-3}	23	3×10^{-3}
	Fugitive Dust Inhalation	--	5×10^{-7}	--	7×10^{-7}				
	Dermal Exposure	0.5	5×10^{-5}	0.7	8×10^{-5}				
	Garden Produce	15	2×10^{-3}	18	2×10^{-3}				
Ephemeral Pool	Soil Ingestion	0.1	2×10^{-4}	0.2	5×10^{-4}	2.5	1×10^{-3}	3.6	3×10^{-3}
	Fugitive Dust Inhalation	--	6×10^{-7}	--	2×10^{-6}				
	Dermal Exposure	0.2	2×10^{-4}	0.2	7×10^{-4}				
	Garden Produce	2.2	8×10^{-4}	3.2	2×10^{-3}				
Horn Rapids Landfill	Soil Ingestion	0.08	5×10^{-4}	1	1×10^{-3}	1.2	3×10^{-3}	5.6	8×10^{-3}
	Fugitive Dust Inhalation	--	4×10^{-5}	--	7×10^{-4}				
	Dermal Exposure	0.001	6×10^{-4}	0.02	2×10^{-3}				
	Garden Produce	0.3	2×10^{-3}	3.6	4×10^{-3}				
	Groundwater Ingestion	0.8	1×10^{-5}	1	1×10^{-5}				
	Inhalation of Volatiles from Groundwater	--	2×10^{-5}	--	3×10^{-5}				

[a]Hazard Index
[b]Lifetime Incremental Cancer Risk
UCL Upper Confidence Limit
-- Indicates not applicable

The purpose of the toxicity assessment is to identify the potential adverse effects associated with exposure to site-related substances and to estimate using numerical toxicity values, the likelihood that these adverse effects may occur based on the extent of the exposure. The toxicity assessment for the BISRA was conducted in accordance with RAGS and is discussed in the HSBRAM.

For carcinogenic chemicals, slope factors (SF's) are estimated using a conservative mathematical model which estimates the relationship between experimental exposure (i.e. doses) and the development of a cancer (i.e. response) that is derived from human or animal studies. Since there is much uncertainty in the dose-response values generated using this procedure, the upper 95 percent confidence limit of the slope of the dose-response curve is normally used in deriving the slope factor.

For non-carcinogenic chemicals, the reference doses (RfD) are used as benchmarks for toxic endpoints of concern. RfD's are derived from data obtained from studies in animals or humans using modification and uncertainty factors that account for uncertainty in the information used to derive the RfD. Uncertainty factors are applied for extrapolation of the no-observed-effects-level (NOEL) in a study population to the RfD used in the risk assessment. A factor of 10 is usually applied to reflect the level of each of the sources of uncertainty listed below:

- Use of lowest observed effect level (LOEL) or other parameters that are less conservative than NOEL;

- Use of data from short-term exposure studies to extrapolate to long-term exposure;

- use of data from animal studies to predict human effects; and

- use of data from homogeneous animal populations or healthy human populations to predict effects in the general population.

A modifying factor may also be incorporated into the RfD to reflect qualitative professional judgements regarding scientific uncertainties not considered by the uncertainty factor, such as the completeness of the data base and the number of animals in the study. Uncertainty factors and modifying factors, as published by EPA in IRIS or HEAST, are presented in Table 9.

For purposes of these baseline risk assessments, the chronic RfD is utilized to evaluate potential noncarcinogenic effects. The chronic RfD is a daily exposure level that is not likely to cause an appreciable lifetime risk of deleterious effects to the general population,

Table 9. Summary of Carcinogenic Toxicity Information for the Contaminants of Potential Concern at the 1100-EM-1 Operable Unit.

Contaminant	Weight of Evidence Classification	Type of Cancer	Oral SF $(mg/kg\text{-}d)^{-1}$	Oral SF (source)	Inhalation SF $(mg/kg\text{-}d)^{-1}$	Inhalation SF (source)
Arsenic	A	Skin, Lung	1.75[a]	Surrogate	5.0×10^{1}	IRIS/HEAST
Beryllium	B2	--	4.3	IRIS	8.4	HEAST
Chromium VI	A	Lung	NA[b]	NA	4.1×10^{1}	IRIS/HEAST
Lead	B2	--	ND	NA	ND	NA
Nickel	A	Lung	NA[b]	NA	8.4×10^{-1}	IRIS
BEHP	B2	--	1.4×10^{-2}	IRIS	1.4×10^{-2}[e]	Surrogate
Beta-HCH	C	--	1.8	IRIS	1.8	IRIS
Chlordane	B2	--	1.3	IRIS	1.3	IRIS
DDT	B2	--	3.4×10^{-1}	IRIS	3.4×10^{-1}	IRIS
Heptachlor	B2	--	4.5	IRIS	4.5	IRIS
PCB's	B2	--	7.7[a]	IRIS	7.7[c]	Surrogate
Tetrachloroethene	B2[c,d]	--	5.2×10^{-2}	Region-10[c]	2×10^{-3}	Region-10[c]
1,1,1-Trichloroethane	NA	NA	NA	NA	NA	NA
Trichloroethene	B2[c,d]	--	1.1×10^{-2}	Region-10[c]	6.0×10^{-3}	Region-10[c]

[a]Based on proposed arsenic unit risk of 5×10^{-5} $\mu g/L$
[b]Not considered carcinogenic by oral route of exposure
[c]As recommended by Superfund Technical Support Center, April 1992 (EPA-10)
[d]Weight-of-evidence classification under evaluation
[e]Surrogate; assumed same as oral SF
-- Indicates not available; presented for Class A carcinogens only
ND = Not determined
NA = Not applicable

Sources: IRIS - Integrated Risk Information (Access: July, 1992),
HEAST - Health Effects Assessment Summary Tables,
unless otherwise indicated

and sensitive subpopulations.

Table 10 summarizes the noncarcinogenic toxicity values for the COPC at the 1100-EM-1 Operable Units evaluated. Oral RfD's have been published for all of the COPC except for PCB's and trichloroethene. Confidence in these RfD's is low or medium for all COPC except nitrate. The confidence in the RfD for nitrate is high because the values are derived from human infant studies. An inhalation RfD is published for only two of the COPC, barium and 1,1,1-trichloroethane. However, 1,1,1-trichloroethane has only been detected in soil gas and soil gas exposures are not evaluated. The RfD for barium is based on a 4-month inhalation study in rats that resulted in fetotoxicity. Based on this reproductive study, an interim RfD is published in HEAST. It is under review and the RfD is subject to change.

The noncarcinogenic effects for the COPC include a variety of effects such as altered blood chemistry profiles for antimony, gastrointestinal irritation for copper, or increased blood pressure for barium. Liver effects, such as increased liver weight, lesions in the liver, or changes in liver enzymes, are associated with thallium, BEHP, chlordane, DDT, heptachlor, and tetrachloroethene. Skin effects are associated with arsenic. No critical effects are identified for beryllium or chromium by the oral route. Nitrate is associated with changes in the capacity of the blood system to transport oxygen.

4. Risk Characterization

The information from the exposure assessment and the toxicity assessment is used to characterize the human health risks. The risk characterization presents quantitative and qualitative descriptions of risk. The quantification of the noncarcinogenic risk and carcinogenic risk is discussed below. Based on the results of the risk assessment using the maximum contaminant concentrations, contaminants that are estimated to have a risk greater than 1×10^{-6} were considered for evaluation using the 95-percent UCL values.

A. Quantification of Non-Carcinogenic Risk

Potential human health hazards associated with exposure to noncarcinogenic substances, or carcinogenic substances with systemic toxicities other than cancer, are evaluated separately from carcinogenic risks. The daily intake over a specified time period (*e.g.*, lifetime or some shorter time period) is compared to an RfD for a similar time period (*e.g.*, chronic RfD or subchronic RfD) to determine a ratio called the hazard quotient (HQ). Estimates of intakes for both the BISRA and BRSRA are based on chronic exposures. The nature of the contaminant sources and the low probability for sudden releases of contaminants from the subunits preclude short-term fluctuations in contaminant concentrations that might produce acute or subchronic effects.

The formula for estimation of the HQ is:

Table 10. Summary of Noncarcinogenic Toxicity Information for Contaminants of Potential Concern at the 1100-EM-1 Operable Unit.

Contaminant	ORAL						INHALATION					
	Oral Rfd (mg/kg-day)	Oral Rfd (basis/source)	Confidence Level	Critical Effect	Uncertainty Factors	Modifying Factors	Inhalation Rfd (mg/kg-d)	Inhalation Rfd (basis/source)	Confidence level	Critical effect	Uncertainty Factor	Modifying Factor
Antimony	4×10^{-4}	Water/IRIS	low	longevity, blood gluc.	1,000	1	--	--	--	--	--	--
Arsenic	3×10^{-4}	Food/IRIS	medium	hyperpigmentation keratosis	3	1	--	--	--	--	--	--
Barium	7×10^{-2}	Water/IRIS	medium	incr. blood press	3	1	1×10^{-4}	HEAST	--	--	1,000	--
Beryllium	5×10^{-3}	Water/IRIS	--	none observed	100	1	--	--	--	--	--	--
Chromium VI	5×10^{-3}	Water/IRIS	low	none	500	1	--	--	--	--	--	--
Copper	4×10^{-2}	EPA Region 10	--	GI irritation	--	--	--	--	--	--	--	--
Lead	ND	--	--	--	--	--	ND	--	--	--	--	--
Manganese	1×10^{-1}	IRIS	--	--	--	--	1.1×10^{-4}	--	--	--	--	--
Nickel	2×10^{-2}	Food/IRIS	medium	decrease body + organ weight	300	1	--	--	--	--	--	--
Thallium	8×10^{-5} 9×10^{-5}	-/IRIS	--	SGOT and serum LDH level	3,000	--	--	--	--	--	--	--
Vanadium	7×10^{-3}	Water/HEAST	--	none	100	--	--	--	--	--	--	--
Zinc	2×10^{-1}	HEAST	--	anemia	10	--	--	--	--	--	--	--
BEHP	2×10^{-2}	IRIS	low	liver weight	1000	1	--	--	--	--	--	--
Beta-HCH	--	--	--	--	--	--	--	--	--	--	--	--
Chlordane	6×10^{-5}	Food/IRIS	low	liver hypertrophy in mice	1,000	1	--	--	--	--	--	--
Heptachlor	5×10^{-4}	Food/IRIS	low	liver weight	300	1	--	--	--	--	--	--
Tetrachlorethene	1×10^{-2}	Gavage/IRIS HEAST 1991	medium	hepatotoxic in mice, weight gain rat	1,000	1	--	--	--	--	--	--
1,1,1-Trichloroethane	9×10^{-2}	Oral/HEAST	--	--	--	--	--	--	--	--	--	--

Sources:
IRIS (Integrated Risk Information System) Access: July, 1992
HEAST (Health Effects Assessment Summary Tables)
unless otherwise indicated

ND = Not determined
-- Indicates not available

$$HQ = \frac{\text{Daily Intake}}{\text{RfD}}$$

If the HQ exceeds unity, the possibility exists for systemic toxic effects. The HQ is not a mathematical prediction of the severity or incidence of the effects, but rather is an indication that effects may occur, especially in sensitive subpopulations. If the HQ is less than unity, then the likelihood of adverse noncarcinogenic effects is small. The HQ for all contaminants for a specific pathway or a scenario can be summed to provide a hazard index (HI) for that pathway or scenario.

RfD's are route specific. Currently, all of the RfD's in IRIS are based on ingestion and inhalation; none have been based on dermal contact. Until more appropriate dose-response factors are available, the oral RfD's should be used to evaluate dermal exposures. The uncertainty regarding these assumptions is discussed below in the uncertainty section.

B. Quantification of Carcinogenic Risk

For carcinogens, risks are estimated as the likelihood of an individual developing cancer over a lifetime as a result of exposure to a potential carcinogen (*i.e.*, incremental or excess ICR). The equation for risk estimation is:

ICR = (Chronic Daily Intake) (Slope Factor)

This linear equation is only valid at low-risk levels (*i.e.*, below estimated risks of 1×10^{-2}), and is an upperbound estimate of the upper 95th percent confidence limit of the slope of the dose-response curve. Thus, one can be reasonably confident that the actual risk is likely to be less than that predicted. Contaminant-specific ICR's are assumed to be additive so that ICR's can be summed for pathways and contaminants to provide pathway, contaminant, or subunit ICR's.

ICR's are presented for those contaminants known to be carcinogenic by a specific route of exposure. For example, chromium is only carcinogenic by the exposure route of fugitive dust inhalation. Consequently, an ICR is presented only for the exposure to chromium through the inhalation of fugitive dust. All COPC that are classified as human carcinogens, or probable human carcinogens, have published inhalation and oral Slope factors (SF's) with two exceptions:

- PCB's and BEHP do not have a published inhalation SF. For purposes of the BISRA, the inhalation SF is assumed to be the same as the oral SF.

- No SF's are published for lead. Therefore, this contaminant of interest is not evaluated for its potential contribution to the subunit total ICR. This may result in an underestimation of the ICR for a subunit.

All of the toxicity factors in IRIS are based on ingestion and inhalation. None of the toxicity factors have been based on dermal contact. Until more appropriate dose-response factors are available, the oral SF's are generally used to evaluate dermal exposures.

The results of the risk characterization for carcinogenic effects are presented below by subunit and summarized in Tables 11 and 12. These risk estimates are based on the maximum detected contaminant concentrations. The 1 x 10^{-6} risk level is considered to be the point of departure for determining remediation goals for alternatives when applicable or relevant and appropriate requirements (ARAR's) are not available or not sufficiently protective.

C. Uncertainty Analysis

A human risk characterization examines the sources of the contaminant, its dispersion in the environment and resulting exposure to humans, and the toxicological effects of such exposure. The risks, both carcinogenic and noncarcinogenic, presented in this risk assessment are conditional estimates given multiple assumptions about exposures, toxicities, and other variables. This discussion focuses on the uncertainties surrounding the projected risks and hazards due to uncertainty in these variables.

Uncertainty Associated with the Identification of COPC's. The soil sampling conducted under the Phase I and Phase II RI's provides confidence that the COPC's at the 1100-EM-1 Operable Unit have been identified. Phase II sampling confirmed sampling data from the earlier remedial investigation activities except as noted below. Additional COPC's have been identified and evaluated in the BISRA because of the more conservative risk-based screening procedure used (*e.g.*, ICR = 1 x 10^{-7} and HQ = 0.1), the availability of new toxicity information (*e.g.*, regarding beryllium), and additional sampling data and maximum concentrations (*e.g.*, regarding PCB's). However, overall results are consistent with the results of the Phase I RI Report.

Uncertainty Associated with the Exposure Assessment. The exposure assessment is based on a large number of assumptions regarding the physical setting of the 1100-EM-1 Operable Unit, and the exposure conditions of the receptor population. For the purpose of the BISRA, a conservative assumption is made that the COPC's being evaluated are readily accessible for worker contact via ingestion, inhalation and dermal exposure pathways. Actual site conditions, however, may substantially limit or preclude such exposures. In most cases, the maximum concentrations detected are not uniformly distributed in the soil and may be several feet below the surface. For the purpose of the BRSRA, a conservative assumption is made that the COPC's being evaluated are readily accessible for receptor contact via ingestion, inhalation, dermal, and garden produce pathways. Actual site conditions, however, may

Table 11. Comparison of the Baseline Industrial Incremental Cancer Risk Assessment Results using the Maximum Contaminant Concentrations and 95-percent UCL for Discolored Soil Site (UN-1100-6), the Ephemeral Pool, and the Horn Rapids Landfill.

Subunit	Pathway	95% UCL Pathway Totals	Maximum Concentration Pathway Totals	95% UCL Subunit Totals	Maximum Concentration Subunit Totals
		ICR	ICR	ICR	ICR
UN-1100-6	Soil Ingestion	2×10^{-5}	3×10^{-5}		
	Fugitive Dust Inhalation	2×10^{-8}	3×10^{-8}		
	Dermal Exposure	2×10^{-6}	3×10^{-6}		
				2×10^{-5}	3×10^{-5}
Ephemeral Pool	Soil Ingestion	9×10^{-6}	3×10^{-5}		
	Fugitive Dust Inhalation	3×10^{-8}	8×10^{-8}		
	Dermal Exposure	1×10^{-5}	3×10^{-5}		
				2×10^{-5}	6×10^{-5}
Horn Rapids Landfill	Soil Ingestion	2×10^{-5}	6×10^{-5}		
	Fugitive Dust Inhalation	2×10^{-6}	3×10^{-5}		
	Dermal Exposure	3×10^{-5}	8×10^{-5}		
				5×10^{-5}	2×10^{-4}

Table 12. Comparison of the Baseline Residential Scenario Risk Assessment Results using the Maximum Contaminant Concentrations and 95-percent UCL for Discolored Soil Site (UN-1100-6), the Ephemeral Pool, and the Horn Rapids Landfill.

Subunit	Pathway	95% UCL Pathway Totals		Maximum Concentration Pathway Totals		95% UCL Subunit Totals		Maximum Concentration Subunit Totals	
		HI[a]	ICR[b]	HI[a]	ICR[b]	HI[a]	ICR[b]	HI[a]	ICR[b]
UN-1100-6	Soil Ingestion	3.0	4×10^{-4}	4.7	6×10^{-4}				
	Fugitive Dust Inhalation	--	5×10^{-8}	--	7×10^{-8}				
	Dermal Exposure	0.5	5×10^{-5}	0.7	8×10^{-5}				
	Garden Produce	15	2×10^{-3}	18	2×10^{-3}				
						18	2×10^{-3}	23	3×10^{-3}
Ephemeral Pool	Soil Ingestion	0.1	2×10^{-4}	0.2	5×10^{-4}				
	Fugitive Dust Inhalation	--	6×10^{-8}	--	2×10^{-7}				
	Dermal Exposure	0.2	2×10^{-4}	0.2	7×10^{-4}				
	Garden Produce	2.2	8×10^{-4}	3.2	2×10^{-3}				
						2.5	1×10^{-3}	3.6	3×10^{-3}
Horn Rapids Landfill	Soil Ingestion	0.08	5×10^{-4}	1	1×10^{-3}				
	Fugitive Dust Inhalation	--	4×10^{-8}	--	6×10^{-5}				
	Dermal Exposure	0.001	6×10^{-4}	0.02	2×10^{-3}				
	Garden Produce	0.3	2×10^{-3}	3.6	4×10^{-3}				
	Groundwater Ingestion	0.8	1×10^{-5}	1	1×10^{-5}				
	Inhalation of Volatiles from Groundwater	--	2×10^{-5}	--	3×10^{-5}				
						1.2	3×10^{-3}	5.6	7×10^{-3}

[a]Hazard Index
[b]Lifetime Incremental Cancer Risk
UCL Upper Confidence Limit
-- Indicates not applicable

substantially limit or preclude such exposures. For example, residential use of the area in the foreseeable future is unlikely.

Other examples include exposure parameters (*i.e.*, body weight, averaging time, contact rate, exposure frequency, and exposure duration) are generally conservative default parameters that represent reasonable maximum values as defined by EPA but may not reflect actual exposure conditions. For example, the soil ingestion exposure pathway uses the assumption that a resident or worker is present and ingesting dirt from the same site 350 days/year (d/yr) for 30 years (residential scenario) or 146 d/yr for 20 years (industrial scenario). In addition, the choice of intake parameters for all exposure pathways is governed by the specific land use evaluated. Any land use change that would increase exposures by workers or indicate a different receptor population would result in a need to reevaluate potential risks.

Absorption factors of contaminants from soil have been derived to evaluate the dermal absorption pathway. Limited data are available on the absorption of chemicals from a soil matrix. Therefore, the assessment of risks may be an overestimation or an underestimation of the actual risk.

Uncertainty Associated with the Toxicity Assessment. Uncertainty is also associated with the toxicity values and toxicity information available to assess potential adverse effects. This uncertainty in the information and the lack of specific toxicity values for some COPC's contribute to uncertainty in the toxicity assessment.

The RfD's and SF's have multiple conservative calculations built into them that can contribute to overestimation of actual risk (*i.e.*, factors of 10 for up to four different levels of uncertainty for RfD's, and the use of a 95-percent upperbound confidence estimate derived from the linearized multi-stage carcinogenic model for SF's). For example, Table 10 indicates that an uncertainty factor of 1,000 is used to calculate the RfD's for chlordane and tetrachloroethene. Table 9 shows that, while beryllium, BEHP, chlordane, and PCB's are evaluated as human carcinogens, the available information indicates that there is inadequate evidence of carcinogenicity in humans. The extrapolation of data from high-dose animal studies to low-dose environmental human exposures may overestimate the risk in the human population because of metabolic differences, repair mechanisms, or different susceptibilities.

Uncertainty in the Toxicity Assessment. Uncertainty is also present in the overall toxicity assessment for several reasons. First, substances have been evaluated qualitatively when there is a lack of toxicity values. Second, route specific toxicity values have been extrapolated from one route to another (*e.g.*, oral to dermal). Additionally, surrogate values are used and potential synergistic or antagonistic interactions of substances have not been evaluated. Conservative assumptions are provided regarding the species of the contaminant present. For example, all chromium is assumed to be hexavalent chromium which is carcinogenic.

Some contaminants, such as PCB's, only have toxicity values for carcinogenic effects (*i.e.*, SF's), but do not have toxicity values for noncarcinogenic effects (*i.e.*, RfD's). These contaminants are known to produce systemic toxic effects in addition to cancer. Without an RfD, quantitative evaluation of these other effects is limited. However, the potential to cause cancer is usually the effect of most concern and is usually the effect that drives risks at most sites. As indicated, surrogates are used to evaluate COPC's when numerical toxicity values are not available. For all COPC's, the level of confidence that key effects have been evaluated is high. The uncertainty surrounding dermal exposures and absorption from dermal exposure is another significant source of uncertainty.

SUMMARY OF BASELINE INDUSTRIAL SCENARIO RISK ASSESSMENT

The baseline industrial scenario risk assessment (BISRA) was conducted according to HSBRAM. Contaminants were determined by comparing maximum detected concentrations of parameters to the UTL values for that parameter. The contaminants of potential concern derived from this comparison were presented in Table 4. The contaminants were evaluated in a two step process to minimize statistical analyses and allow health risk based comparison of maximum value concentrations and 95-percent upper confidence limit (UCL) concentrations. Maximum concentrations were used not only for preliminary risk based screening but also for the initial risk based assessment calculations. If a health risk was indicated using maximum concentration, then the 95-percent UCL concentration was used to refine quantification of the health risk.

The maximum concentrations of contaminants of potential concern detected within each subunit were evaluated for each subunit. Conservative assumptions were made with respect to the contaminants present. For three subunits, UN-1100-6 (Discolored Soil Site), the Ephemeral Pool, and HRL, soil contaminants that were estimated to have an Incremental Cancer Risk (ICR) greater than 1×10^{-6}, based on the maximum detected contaminant concentrations, were evaluated using a 95-percent UCL concentration.

The exposure pathways for the industrial were defined in the HSBRAM. These are conservative default parameters for a generic industrial worker. The BISRA evaluated only pathways associated with exposure to soils (*i.e.*, soil ingestion, dermal exposure to soil, and fugitive dust inhalation). Potential exposures associated with groundwater and surface water were not evaluated in this BISRA because neither groundwater nor surface water is withdrawn from the 1100 Area. Potable water is provided by the city of Richland. The air inhalation pathway assumes exposure to windblown contaminants in dust directly from each subunit. The EPA Fugitive Dust Model (FDM) was used to estimate concentrations of airborne particulates at each site based on conservative estimation of soil and climatic conditions. Chromium present in the soil at HRL was the only contaminant that may be associated with risks greater than 1×10^{-6}. However, all chromium was assumed to be hexavalent chromium which is a conservative assumption and unlikely to be representative of the true valence states present. Hexavalent chromium under aerobic conditions is reduced to trivalent chromium, an essential nutrient. Adverse effects have not been associated with the trivalent chromium form.

Evaluation of the potential contaminants of concern using the maximum and 95-percent UCL's identified the contaminants of concern for the individual subunits in the 1100-EM-1. Contaminants of concern for individual subunits as determined in the BISRA are:

UN-1100-6 (Discolored Soil Site) - BEHP
Ephemeral Pool - PCB's
HRL - Chromium - PCB's

A summary of the industrial scenario risk assessment based on the 95-percent UCL for UN-1100-6 (Discolored Soil Site), Ephemeral Pool, and HRL was presented in Table 11. The risk assessments for the Battery Acid Pit (1100-1), the Paint and Solvent Pit (1100-2), the Antifreeze and Degreaser Pit (1100-3), and the Antifreeze Tank Site (1100-4) demonstrated that the Hazard Indices were all less than 1, and the incremetnal cancer risks were all less than 1 x 10^{-6}.

Chromium was identified as a contaminant of concern at HRL due to the fugitive dust exposure pathway. This determination was made using maximum and 95-percent UCL soil chromium concentrations taken at depths from 0 to 4.6 m (0-15 ft) in selected boreholes and exploratory trenches. Using these values in risk based screening within the risk assessment is appropriate. However, remedial actions to protect the ambient air quality from contaminated fugitive dust migration should specifically apply to surface soils. Upon reevaluating sample analyses from chromium in only the top 0.6 m (2 ft) of HRL, a mean concentration for chromium in soils of 9.06 mg/kg with a 95-percent UCL of 9.76 mg/kg was calculated. The Phase I RI reported chromium in background soils with a mean concentration of 9.19 mg/kg and a 95-percent UTL of 12.9 mg/kg providing evidence that chromium concentrations in the HRL surface soils are typical of the site. Using the 95-percent UCL of 9.76 mg/kg to recalculate the incremental cancer risk of fugitive dust from the HRL gives a risk of 2 x 10^{-7} under the industrial scenario. Therefore, chromium was determined not to be a contaminant of concern and was not considered further.

SUMMARY OF BASELINE RESIDENTIAL SCENARIO RISK ASSESSMENT

The BRSRA was conducted to address uncertainty associated with future land use at the site.

Evaluation of the potential contaminants of concern using the maximum and 95-percent UCL identified the contaminants of concern for the individual subunits in the 1100-EM-1. Contaminants of concern for individual subunits as determined in the BRSRA are:

UN-1100-6 (Discolored Soil Site) - BEHP, Chlordane
Ephemeral Pool - Chlordane, PCB's
HRL - Nitrate, PCB's, TCE

A summary of the residential scenario risk assessment based on the 95-percent UCL for UN-1100-6 (Discolored Soil Site), Ephemeral Pool, and HRL was presented in Table 12. The risk assessments for the Battery Acid Pit (1100-1), the Paint and Solvent Pit (1100-2), the Antifreeze and Degreaser Pit (1100-3), and the Antifreeze Tank Site (1100-4) demonstrated that the Hazard Indices were all less than 1, and the incremetnal cancer risks were all less than 1×10^{-6}.

SUMMARY OF ECOLOGICAL RISK ASSESSMENT FOR THE 1100-EM-1 OPERABLE UNIT

The objective of the Ecological Risk Assessment is to provide an evaluation of the site specific ecological risks. This Ecological Risk Assessment includes a problem definition, analysis, and risk characterization. Given the uncertainty in information available, it was not practical to perform risk calculations for this evaluation. Ecological risk was estimated by comparing exposure to the contaminant toxicity.

Using highly conservative assumptions and models, no uptake rates for the long-billed curlew or the Swainson's hawk exceeded toxicity values. Contaminants with uptake rates that were closest to toxicity values were zinc for the hawk and BEHP for the long-billed curlew, which were approximately 10 and 20 times less than toxicity values, respectively. Therefore, it is unlikely that contaminants of potential concern at 1100-EM-1 would have an impact on these birds that was distinguishable from background conditions. Even though there are significant uncertainties in this assessment, there has been little evidence of ecological damage at the site.

Problem Definition. The problem definition involved identifying ecosystems potentially at risk, the stressor characteristics, ecological effects, and the selection of assessment and measurement endpoints. Potentially sensitive habitats chosen for the 1100-EM-1 site include habitats known to be frequented by designated or proposed, endangered or threatened species. In determining ecosystems potentially at risk at 1100 EM-1, only terrestrial organisms were considered.

The dominant plant species within the 1100 Area are sagebrush-bitterbrush and cheatgrass. The sandwort is designated a monitor species. Of the birds that may inhabit the 1100 Area, the peregrine falcon and ferruginous hawk are endangered and threatened, respectively. The Swainson's hawk, golden eagle, and prairie falcon are candidate species and the long-billed curlew is a monitored species. No threatened or endangered species of mammals, reptiles, or insects are known to inhabit the 1100 Area. However, the grasshopper mouse and sagebrush vole are monitored, and the pocket gopher and striped whipsnake are candidate species.

No toxicological studies were performed on species inhabiting 1100-EM-1 for the Phase I or Phase II RI. The toxicological effects on species exposed to the COPC are assumed to be those addressed in the derivation of parameters such as the No Observed Adverse Effect Level (NOAEL). These parameters are used in the analysis and characterization sections.

Phase I field observations of the ecology of 1100-EM-1 showed that there was no evidence of adverse impacts from the COPC to the flora and fauna inhabiting any of the subunits, except for the UN-1100-6 (Discolored Soil Site). Except for a single clump of grass, there is no vegetation growing in the depression of the UN-1100-6 subunit (Discolored Soil Site). The only evidence of ecological damage at the operable unit is this apparent lack of vegetative growth at this subunit.

Assessment endpoints are the properties of habitats of potential concern that are used to assess the state of an ecosystem. These endpoints "must be of ecological importance and of direct management relevance...." When selecting assessment endpoints, it is preferable to chose specific cases (such as reduced population size). However, with the lack of data regarding the effects of contaminants at the site on organisms known to inhabit the site, this was not possible. Therefore, adverse effects that generate the toxicological parameters (NOAEL, *etc.*) on important species (*i.e.*, the ferruginous hawk and peregrine falcon) were considered assessment endpoints. It would be preferable to use effects on these species as measurement endpoints, but data for the analog species (Swainson's hawk and long-billed curlew) were more readily available.

Analysis. The analysis involved performing an exposure and toxicity assessment. This involved first identifying the exposure pathways and secondly, calculating intake rates for the receptor population (Swainson's hawk and long-billed curlew).

COPC uptake calculations for the Swainson's hawk and long-billed curlew were performed according to Risk Assessment Guidance for Superfund. Table 13 lists maximum contaminant concentrations and plant and small mammal uptake factors used in uptake calculations. Similarly, the results of the uptake calculations are reported in Table 14. Appropriate parameters were not always available, so conservative estimations, taken from previously conducted studies, were made whenever necessary. Intake rates for the analog species (Swainson's hawk and long-billed curlew) were compared to toxicological values in Table 15. Values for birds were used whenever possible.

Risk Characterization. Given the uncertainty in information available, it was not practical to perform risk calculations for this evaluation. Ecological risk was estimated by comparing exposure to the contaminant toxicity.

None of the uptake rates in Table 13 exceed the toxicologic values in Table 15. For the Swainson's hawk, uptake rates for zinc, BEHP, beta-Hexachlorocyclohexane (β-HCH), 1,1,1--trichloro-2, 2-bis(p-chlorophenyl)ethane (DDT), and PCB were between 10 and 80 times lower than the corresponding toxicity value. Uptake rates for copper, thallium, and chlordane were between 2,000 and 20,000 times lower, and the remaining uptake rates were more than 300,000 times below toxicity values. For the long-billed curlew, arsenic, barium,

Table 13. Values used in Uptake Calculations

Contaminant	Maximum Concentration, mg/kg	Plant Uptake Factor	Small Mammal Uptake Factor
Antimony	15.6	0.01[b]	0.002[c]
Arsenic	3.6	0.04[a]	0.002[c]
Barium	1320	0.001[b]	0.001[c]
Beryllium	1.3	0.43[a]	0.001[c]
Chromium	17.1	0.2[a]	0.0092[c]
Copper	58.6	0.3[a]	0.15[a]
Lead	482	0.008[a]	0.0004[c]
Nickel	174	0.09[a]	0.002[c]
Thallium	0.42	0.5[b]	0.02[a]
Vanadium	87.3	0.04[b]	0.0092[c]
Zinc	408	0.80[a]	1.1[a]
BEHP	24000	0.38[a]	5.5[a]
Beta-HCH	0.094	0.38[a]	15.6[a]
Chlordane	1.86	0.05[a]	5.5[a]
DDT	2.0	0.11[a]	5.7[a]
Heptachlor	0.065	0.02[a]	14.2[a]
PCB's	100	0.38[a]	5.5[a]

[a] Values from EPA, 1986 mg/g tissue DW (mg/g soil DW)-1
[b] Values from Kabatus-Pendias and Pendias, 1985, mg/g tissue DW (mg/g soil DW)-1
[c] Values from Clement Assoc., 1988, d/kg

Table 14. Results of Uptake Calculations

Contaminant	Plant Uptake mg/kg	Insect Uptake mg/kg	Small Mammal Uptake mg/kg	Swainson's Hawk Uptake Rate mg/kg-d	Long-Billed Curlew Uptake Rate mg/kg-d
Antimony	0.16	0.16	1.2×10^{-6}	1.6×10^{-8}	1.1×10^{-3}
Arsenic	0.14	0.14	1.1×10^{-6}	1.4×10^{-8}	0.00079
Barium	1.32	1.32	5.2×10^{-6}	6.2×10^{-8}	0.0072
Beryllium	0.56	0.56	2.2×10^{-6}	2.8×10^{-8}	0.0031
Chromium	3.42	3.42	1.2×10^{-4}	1.5×10^{-6}	0.019
Copper	17.6	17.6	2.6	0.043	0.096
Lead	3.85	3.85	6.0×10^{-6}	7.4×10^{-8}	0.021
Nickel	15.7	15.7	1.2×10^{-4}	1.6×10^{-6}	0.086
Thallium	0.21	0.21	4.2×10^{-3}	5.2×10^{-5}	0.0011
Vanadium	3.5	3.5	1.3×10^{-4}	1.5×10^{-6}	0.019
Zinc	326	326	360	4.4	1.8
BEHP	9100	9100	50000	0.12	1.0
Beta-HCH	0.035	0.035	0.56	0.0069	2.0×10^{-4}
Chlordane	0.093	0.093	0.51	1.3×10^{-6}	1.0×10^{-5}
DDT	0.22	0.22	1.3	0.015	0.0012
Heptachlor	0.0013	0.0013	0.018	4.4×10^{-8}	1.4×10^{-7}
PCB's	38	38	210	2.5	0.2

Table 15. Toxicological Values

Contaminant	Toxicity*	Toxicity Parameter	Organism	Comments
Antimony	0.35 mg/kg bw/d	LOAEL	Rat	Chronic Oral
Arsenic	0.014 mg/kg/d	LOAEL	Human	Chronic Oral
Barium	0.21 mg/kg/d	NOAEL	Human	Chronic drinking
Beryllium	0.54 mg/kg bw/d	NOAEL	Rat	Chronic Oral
Chromium	2.4 mg/kg bw/d	NOAEL	Rat	1 year drinking
Copper	152 mg/kg	TDLo	Rat	Chronic Oral
Lead	4.3 mg/kg/d	LOAEL	Hawk	Subchronic Oral
Nickel	5 mg/kg/d	NOAEL	Rat	Chronic Oral
Thallium	0.7 mg/kg/d	LOAEL	Rat	Chronic Oral
Vanadium	0.89 mg/kg/d	NOAEL	Rat	Chronic Oral
Zinc	96 mg/kg/d	NOAEL	Mouse	Drinking water
BEHP	19 mg/kg bw/d	LOAEL	Guinea Pig	Chronic Oral
Beta-HCH	0.33 mg/kg/d	NOAEL	Rat	Subchronic Oral
Chlordane	0.055 mg/kg/day	NOEL	Rat	30 mo Oral
DDT	0.49 mg/kg/d	NOAEL	Hawk	Lifetime dosing
Heptachlor	0.15 mg/kg/day	NOEL	Rat	2-year Oral
PCB's	325 mg/kg	TDLo	Mammals	Subchronic Oral

*Values from IRIS
LOAEL = Lowest Observed Adverse Effect Level
NOAEL = No Observed Adverse Effect Level
TDLo = Toxic Dose Low
NOEL = No Observed Effect Level

nickel, vanadium, zinc, and BEHP had uptake rates 20 to 100 times less than toxicity values. The other contaminants were more than 100 times less than toxicity values.

Uncertainty Analysis. There were many sources of uncertainty in the exposure assessment and risk characterization for the ecological evaluation of 1100-EM-1. All information regarding the presence and behavior of species at the site, the exposure to contaminants, and toxicity of contaminants was estimated and extrapolated from information available from previous studies. Limited ecological data were taken from the site, therefore, the most conservative and simple models were used to determine the ecological impact. Thus, the exposure assessment represents the worst case scenario and the comparison of toxicity to exposure was highly conservative.

Qualitative Risk Assessment for 1100-EM-2, 1100-EM-3 and 1100-IU-1

A qualitative evaluation of overall potential risk from the 1100-EM-2, 1100-EM-3, and 1100-IU-1 operable units was made by comparing possible waste site contaminant levels with existing State and Federal health-based guidelines. The identification of potential waste types for the 1100-EM-2, 1100-EM-3, and 1100-IU-1 Operable Units is based upon historical information about typical chemicals and materials that were used at the sites collected from the WIDS, previous site investigations, and site reconnaissance activities. The COPC's for each operable unit and a comparison to risk-based cleanup levels is presented below.

1100-EM-2 Area

The potential contaminants of concern for the 1100-EM-2 Area are chlordane; 1,1,1-trichloroethane (TCA) (700 Area UST waste solvent tank); and polychlorinated biphenyls (PCB's) (1100 Area bus shop), see Table 16.

Table 16. Potential Contaminants for the 1100-EM-2 Operable Unit

Waste Management Unit	Potential Contaminant
700 Area UST Waste Solvent Tank	TCA Chlordane
1100 Area Bus Shop	PCB's

1100-EM-3 Area

In the 1100-EM-3 Area, the potential contaminants include nitrates (1234 storage yard), lead (3000 Area Jones Yard HWSA), carbon tetrachloride (CCl_4) (1262 solvent tanks), and PCB's (1262 transformer pad), see Table 17.

Table 17. Potential Contaminants for the 1100-EM-3 Operable Unit

Waste Management Unit	Potential Contaminant
1234 Storage Yard	Nitrates
3000 Area Jones Yard HWSA	Lead
1262 Solvent Tanks	CCl_4
1262 Transformer Pad	PCB's

1100-IU-1 Area (NIKE Missile Site)

Studies of NIKE missile sites for DOE by IT Corporation revealed that releases fall into four general categories: incidental, accidental, intentional, and unanticipated. Incidental releases consisted of minor release accompanying normal site operations. Accidental releases occurred due to fuel spillage while filling UST's, and leakage of hydraulic fluid from missiles, launchers, and elevators. Intentional releases involved the dumping of unsymmetrical dimethylhydrazine (UDMH), waste solvents, and oils. Unanticipated releases from transformers containing PCB's resulted from vandalism or negligence, and asbestos released during the demolition of buildings.

Typical chemicals used at NIKE sites include aniline, petroleum distillates, chlorinated solvents such as CCl_4, trichloroethene, trichloroethane, and tetrachloroethene, alcohols, inhibited red fuming nitric acid, UDMH, phosphoric acid, alodine powder, chromium oxides, acetone, paints containing chromium and lead, tricresyl phosphate, ethylene glycol, pesticides, herbicides, PCB's (transformer oil), and hydraulic fluid (see Table 18).

In place of quantitative human health and ecological risk assessments, a qualitative evaluation was made by presenting federal and state risk-based cleanup goals and advisories for known or potential contaminants. Table 19 presents a baseline cleanup levels for protection of human health. These values will be used to establish cleanup goals for these operable units.

Table 18. Potential Contaminants for the 1100-IU-1 Operable Unit

Waste Management Unit	Potential Contaminant
Missile Maintenance & Assembly Area Transformer Pad	PCB's
Anti-Aircraft Artillery	Unexploded Ordnance
Missile Assembly Area	Petroleum Distillates
	Chlorinated Solvents
	Alcohols
Missile Fueling and Warheading Area	Dimethylhydrazine (UDMH)
	Inhibited red fuming nitric acid (IRFNA)
	Aniline
	Furfuryl Alcohol
	Ethylene oxide
	Hydrocarbons such as JP-4 fuel
Missile Maintenance and Testing	Phosphoric Acid
	Alodine powder
	Chromium trioxide
	Sodium dichromate
	Petroleum distillates
	CCl_4
	Trichloroethene
	Trichloroethane
	Tetrachloroethene
	Alcohol
	Acetone
	Paints containing Cr and Pb
	Missile hydraulic fluid
	Tricresyl Phosphate
General Launcher and Magazine Maintenance	Hydraulic fluid
	Paints
	Solvents
Control Center Operations Maintenance	Solvents used for cleaning electrical parts
	Ethylene glycol
Vehicle Maintenance	Petroleum, oils and lubricants
Facility Maintenance	Lead paints
	Pesticides and herbicides
Utilities	Transformers (PCB's), above and below ground storage tanks used for gasoline or fuel oil, and hydraulic fluid
Deactivation	Solvents, fuels, paints, asbestos-containing debris

Table 19. Potential Contaminant and Risk-Based Concentrations for 1100-EM-2, 1100-EM-3, and 1100-IU-1 Soils
(mg/kg)

	EPA Risk Based Concentrations			MTCA A	MTCA B		MTCA C	
Contaminant	10^{-6}	10^{-4}	HQ = 1		Carcinogen	Non-carcinogen	Carcinogen	Non-carcinogen
1,1,1-Trichloroethane	NA	NA	20,000	20	-	7200	-	28,800
PCBs	0.08	8	NA	1.0	0.13	-	5.19	-
Carbon Tetrachloride	5	500	200	-	7.69	56	308	224
Aniline	-	-	-	-	175	-	7020	-
Furfuryl Alcohol	-	-	-	-	-	240	-	960
Dimethylhydrazine	-	-	-	-	0.000714	-	0.0286	-
Acetone	NA	NA	30,000	-	-	8000	-	32,000
Chromium Trioxide	NA	NA	-	-	-	-	-	1600
Cr Paints	NA	NA	-	-	-	-	-	1600
Sodium Dichromate	NA	NA	-	-	-	-	-	1600
Trichloroethylene (TCE)	60	6000	NA	0.5	-	-	3640	-
Benzene	20	2000	NA	0.5	34.5	-	1380	-
Toluene	NA	NA	50,000	40	-	16,000	-	64,000
Ethylbenzene	NA	NA	30,000	20	-	8000	-	32,000
Xylenes	NA	NA	500,000	20	-	160,000	-	640,000
Lead	-	-	-	250	-	-	-	-
Tetrachloroethene (PCE)	-	-	-	0.5	-	-	-	-
TPH (gasoline)	-	-	-	100	-	-	-	-
TPH (diesel)	-	-	-	200	-	-	-	-
PAH's	-	-	-	1.0	0.2	-	6.9	-

VII. REMEDIAL ACTION OBJECTIVES

Remedial Action Objectives (RAO's) are site specific goals that define the extent of cleanup necessary to achieve the specified level of remediation at the site. The RAO's include preliminary remediation goals derived from ARAR's, the points of compliance, and the restoration timeframe for the remedial action. These goals are formulated to meet the overall goal of CERCLA, which is to provide protection to overall human health and the environment.

Contaminants of potential concern were identified based on a statistical and risk-based screening process in site-affected media. The potential for adverse effects to human health and the environment were initially identified in the Phase I RI report, and were further evaluated in the BISRA and the BRSRA. Findings of these assessments are summarized in the previous section. There are no contaminants that pose risks to ecological receptors.

Land Use. A key component in the identification of RAO's is the determination of current and potential future land use at the site. The current use and long range planning by the city, county, and Hanford Site planners show the 1100-EM-1, EM-2 and EM-3 areas as light industrial. The 1100-IU-1 is entirely within the Arid Lands Ecological (ALE) Reserve. Area planners expect that the current land use patterns will remain unchanged as long as the Hanford Site exists. If control of the site is relinquished by the Government, land use in the vicinity of the 1100 Area would be expected to remain unchanged due to the presence of established commercial and industrial facilities that could be readily utilized by the private sector. The ALE is expected to remain a wildlife management area for the foreseeable future. These long range land use plans are not predictors of long-term land use (beyond 20 to 30 years) and should not be used as predictors of land use beyond reasonable lengths of time, nor for land use changes resulting from longer term events.

The Hanford Future Site Users Working Group (the Working Group) was convened in April of 1992 to develop recommendations concerning the potential use of lands after cleanup. These recommendations are to be used as input into the Hanford Remedial Actions Environmental Impact Statement (HRA-EIS) which is not expected to be published until 1995 or later. The Working Group issued their report in December 1992 and proposed that the cleanup options at the 1100 Area be based on eventual unrestricted land use.

Factors that were considered in conjunction with the Working Group proposals include: (1) that contaminated sites which would exist indefinitely (beyond any reasonable time for assured institutional control) would be cleaned up for standards of unrestricted use where practicable, and (2) that institutional controls (such as land and groundwater restrictions) be implemented for sites associated with low risks where it can be shown that the contaminant would degrade or attenuate within a reasonable period of time or, for sites where contaminants would remain in place above unrestricted use cleanup goals, where it can be shown that meeting the more stringent cleanup goal is not practicable. For this the 1100 Area, a reasonable period of time was identified by the Working Group as "as soon as possible (by 2018)". This time frame coincides with the TPA date for completion of cleanup actions. This time frame also approximates the upper limit of reliability on long range land use plans which have been used by DOE to determine the near-term site use.

Chemicals and Media of Concern. Risks from soil and groundwater contaminants of concern were identified at levels that exceed the EPA risk threshold and may, therefore, pose a potential threat to human health. The NCP requires that the overall incremental cancer risk (ICR) at a site not exceed the range of 1×10^{-6} to 1×10^{-4}. The State of Washington's Model Toxics Control Act (MTCA) is more stringent and requires that this risk not exceed 1×10^{-6} to 1×10^{-5}. For systemic toxicants or noncarcinogenic contaminants, acceptable exposure levels shall represent levels to which the human population may be exposed without adverse effect during a lifetime or part of a lifetime. This is represented by a hazard quotient (HQ). For sites in the state of Washington where the cumulative carcinogenic site risk to an individual based on reasonable maximum exposure for both current and future land use is less than 1×10^{-5}, and the noncarcinogenic HQ is less than 1, action generally is not warranted unless there are adverse environmental impacts. However, if MCL's or nonzero MCLG's are exceeded, action generally is warranted. Risks associated with 1100 Area contaminants are summarized in Table 20.

Friable asbestos was found to be dispersed throughout HRL. The risk assessment did not evaluate the risks associated with this contaminant because there are no published reference doses or carcinogenic potency factors for asbestos. However, releases of friable asbestos in fugitive dust does pose health risks to onsite workers.

The Phase II RI has confirmed the presence of groundwater contaminants at the site. These contaminants do not present any risk to human health under the current and future industrial land use scenarios for the site because: (1) downgradient users are supplied by Richland's water distribution system, and (2) the Phase I and II RI determined that the North Richland well field is not impacted by the HRL contaminant plume and is not at risk. The uncontrolled land use future uncertainty assessment using residential exposure indicates a higher risk than the industrial scenario. However, that risk (3×10^{-5}) is within the acceptable risk range established by the NCP but is higher than that prescribed by MTCA.

TCE in groundwater was calculated to have an ICR of 3×10^{-5} for the uncertainty risk assessment. Generally, where groundwater is a potential source of drinking water, clean up requirements are set at levels which reduce the ICR to 1×10^{-6} or to MCL's. Because of the uncertain use of the aquifer as a potential source of drinking water in the long-term future, TCE was identified as a contaminant of concern. The hazard quotient (HQ) associated with nitrate in the groundwater for the uncertainty risk assessment was calculated to be 0.8. Typically, a contaminant of concern has a HQ of 1 or greater. However, nitrate is present at levels above MCL's making it a contaminant of concern to be monitored.

TABLE 20. COMPARISON OF CONTAMINANT HAZARD QUOTIENTS (HQ) AND INCREMENTAL CANCER RISKS (ICR)

Operable Subunit	Contaminant	ICR Based on BISRA				ICR Based on BRSRA			
		Max Conc		95-percent UCL		Max Conc		95-percent UCL	
		HQ	ICR	HQ	ICR	HQ	ICR	HQ	ICR
UN-1100-6	BEHP	0.4	3×10^{-5}	0.3	2×10^{-5}	21	3×10^{-3}	16	2×10^{-3}
	Chlordane	0.02	4×10^{-7}	0.01	4×10^{-7}	2	8×10^{-5}	2	7×10^{-5}
Ephemeral Pool	Chlordane	0.03	6×10^{-7}	0.02	4×10^{-7}	3.6	1×10^{-4}	3	8×10^{-5}
	PCB's	--	6×10^{-5}	--	2×10^{-5}	--	3×10^{-3}	--	1×10^{-3}
HRL	Arsenic	0.006	1×10^{-6}	0.001	2×10^{-7}	0.1	2×10^{-5}	0.03	4×10^{-6}
	Beryllium	0.00007	5×10^{-7}	--	--	0.006	5×10^{-5}	0.002	2×10^{-5}
	Chromium	0.07	3×10^{-4}	0.005	2×10^{-5}	4.5	6×10^{-4}	0.4	4×10^{-5}
	Lead[1]	--	--	--	--	--	--[1]	--	--[1]
	PCB's	--	1×10^{-4}	--	5×10^{-5}	--	7×10^{-3}	--	3×10^{-3}
	TCE[2]	--	--	--	--	--	4×10^{-5}	--	3×10^{-5}
	Nitrate[2]	--	--	--	--	1	--	0.8	--

[1] Lead was evaluated using EPA's Uptake Biokinetic (UBK) Model and was determined not to be present at levels which would cause adverse human health effects.

[2] Groundwater contaminants.

Soil RAO's. RAO's have been identified for the contaminated near surface and subsurface soils at the Discolored Soil Site, the Ephemeral Pool, and HRL based on detected concentrations of chemicals of concern exceeding ARAR's. Because there were no risks from the Battery Acid Pit (1100-1), the Paint and Solvent Pit (1100-2), the Antifreeze and Degreaser Pit (1100-3), and the Antifreeze Tank Site (1100-4), no action is necessary. All RAO's shall minimize exposure to contaminated soils during remediation. These specific operable unit RAO's are:

- **Discolored Soil Site (UN-1100-6)**

  a. Prevent the ingestion of and dermal contact with soils having BEHP concentrations greater than the MTCA B cleanup level of 71 mg/kg.

  b. For remedial actions that leave any contaminant in place above MTCA B levels, provide adequate institutional controls to monitor the site after remediation and to prevent potential future receptor exposure to contaminants.

- **Ephemeral Pool**

  a. Prevent the ingestion of and dermal contact with soils having PCB concentrations greater than the MTCA A cleanup level of 1 mg/kg.

  b. For remedial actions that leave any contaminant in place above MTCA A levels, provide adequate institutional controls to monitor the site after remediation and to prevent potential future receptor exposure to contaminants.

- **Horn Rapids Landfill**

  a. Prevent soil ingestion of and dermal contact with soils having PCB's at concentrations greater than the MTCA C cleanup level of 5.2 mg/kg.

  b. Prevent inhalation of fugitive dust from soils that may contain asbestos fibers.

  c. For remedial actions that leave any contaminant in place above MTCA C levels, provide adequate institutional controls to monitor the site after remediation and to prevent future receptor exposure to contaminants.

Groundwater RAO's. For the contaminated groundwater, the following RAO's based on chemical-specific ARAR's are identified.

  a. Attain the SDWA MCL of 5 μg/l for TCE at the designated point of compliance. The point of compliance is to be defined by EPA and Ecology. Monitoring for compliance will be performed at the defined point.

b. Protect environmental receptors in surface waters by reducing groundwater contaminant concentrations in the plume to levels that are safe for biological and human receptors that may be affected at the groundwater discharge point to the Columbia River.

Residual Risks Post-Achievement of RAO's. Residual risks after meeting RAO's were calculated based on the uncertain residential land use scenario for soils at the Discolored Soil Site and the Ephemeral Pool, and the industrial land use scenario for soils at the HRL. The uncertain residential land use scenario was used to determine residual risks for groundwater. These risks are presented in Tables 21 and 22. Site risks from contaminated soils are reduced from 2×10^{-3} to 2×10^{-6}, 1×10^{-3} to 3×10^{-5}, and 7×10^{-5} to 8×10^{-6}, for 99.9, 97, and 88-percent reductions in incremental cancer risk at the Discolored Soil Site, the Ephemeral Pool, and HRL, respectively. Groundwater residual risks were calculated using the uncertain residential scenario. For nitrates, remediation to the RAO gives a hazard quotient of 0.17 compared to a 95-percent UCL based hazard quotient of 0.8. For TCE, the total incremental cancer risk due to inhalation and ingestion is reduced from 3×10^{-5} based on the 95-percent UCL to 2×10^{-6} for a 93-percent reduction in risk.

Potential risks to human health and the environment associated with remedial activities at the site also need to be addressed. Specifically, due to the presence of asbestos in HRL soils, fugitive dust may poses a health threat to remedial workers. At the HRL and other sites, remedial activities must include the suppression of fugitive dust.

Remediation Timeframe. Soil and groundwater remediation will generally be accomplished in timeframes that are appropriate for the risks associated with the site. Soil sites are expected to be remediated within 12 to 18 months of the implementation of remedial actions. Groundwater is expected to achieve the MCL of 5 ppb for TCE by the year 2018.

TABLE 21. RESIDUAL RISKS ASSOCIATED WITH SOIL RAO's

Operable Subunit	Contaminant	RAO Conc (mg/kg)	Soil Ingestion		Fugitive Dust		Dermal Exposure		Contaminant Totals		Subunit Totals	
			HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk
UN-1100-6 Discolored Soil Site [1]	BEHP	71 [2]	0.013	2×10^{-6}	--	2×10^{-9}	0.002	2×10^{-7}	0.015	2×10^{-6}	0.015	2×10^{-6}
Ephemeral Pool [1]	PCB's	1 [3]	--	1×10^{-5}	--	4×10^{-8}	--	2×10^{-5}	--	3×10^{-5}	--	3×10^{-5}
HRL	PCB's	5.2 [4]	--	4×10^{-6}	--	3×10^{-7}	--	4×10^{-6}	--	8×10^{-6}	--	8×10^{-6}
									Maximum Site Risks		0.015	3×10^{-5}

[1] Residual risk associated with residential scenario.
[2] RAO for subsurface soils based on MTCA Method B.
[3] RAO for subsurface soils based on MTCA Method A Table.
[4] RAO for subsurface soils based MTCA Method C.

TABLE 22. RESIDUAL RISKS ASSOCIATED WITH GROUNDWATER RAO's (RESIDENTIAL SCENARIO)[1]

Operable Subunit	Contaminant	RAO Conc (mg/l)	Water Ingestion		Inhalation of Household Release		Dermal Exposure		Contaminant Totals		Subunit Totals	
			HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk	HQ	Risk
Site-wide Groundwater	TCE	0.005	--	6×10^{-7}	--	1×10^{-6}	--	--	--	2×10^{-6}		
	Nitrate	10	0.17	--	--	--	--	--	0.17	--	0.17	2×10^{-6}
									Site Totals		.17	2×10^{-6}

[1] RAO's for groundwater are based on SDWA MCL's.

VIII. DESCRIPTION OF ALTERNATIVES

A. Soil Alternatives

1. Discolored Soil Site

Alternative DSS-0: No Action. Evaluation of this alternative is required under CERCLA; it serves as a reference against which other alternatives can be compared. Under this alternative, no action would be taken to remove, treat, or contain contamination at this site and no institutional controls would be established to prevent exposure. There is no cost associated with this alternative.

Alternative DSS-1: Onsite Bioremediation. A diked treatment area approximately 30.5 m by 36.6 m (100 ft by 120 ft) would be constructed onsite and lined with an impervious geomembrane. The soils contaminated with BEHP above 71 mg/kg, estimated to be a maximum of 340 m^3 (440 yd^3), would be excavated and placed into the treatment area. A sprinkler system would deliver a mixture of water, nutrients, and microorganisms, specifically cultured for their ability to degrade BEHP, to the soils approximately twice a week. The soils would be tilled after each application of this mixture to provide additional mixing and aeration. Excess water would be collected and recycled. A bioreactor would be required onsite to culture the microorganisms. It was assumed that bioremediation would be conducted for 36 weeks a year with a suspension of operations during the colder winter months, which inhibit bacterial growth and respiration. The entire remediation process was assumed to take 2 years. After remediation, the soils would be placed back at the Discolored Soil Site and the area would be regraded and covered with 15 cm (6 in) of topsoil. The total estimated present worth cost for this alternative is $997,000 (includes capital and O&M costs).

Alternative DSS-2: Onsite Incineration. Onsite incineration would be accomplished by using a small mobile incinerator capable of processing approximately 4.5 metric tons (5-tons) of contaminated soil per day. There would be approximately 770 metric tons (840 tons) of soils contaminated with BEHP to be processed. Combustion off gases would be treated to meet air quality standards for emissions through use of a secondary combustion chamber and wet scrubbers. Ashes would be quenched with water and the quench water would be recirculated. After incineration, the treated soil would be placed back at the operable subunit and the area would be regraded and covered with 15 cm (6 in) of clean topsoil. Materials would be excavated using standard equipment for earthwork. Confirmatory testing would be conducted to ensure that all contaminated soils above cleanup levels are removed. A 30.5-m (100-ft) graded square pad would be required to house the incinerator. The total estimated present worth cost for this alternative is $1,491,000 (includes capital and O&M costs).

Alternative DSS-3: Offsite Incineration. Approximately 770 metric tons (840 tons) of soils contaminated with BEHP would be excavated and shipped to an offsite incinerator. DOT-licensed hazardous waste haulers would carry the contaminated soils in bulk truck loads to a RCRA licensed facility. After incineration, the ash would be disposed of in this facility's ash disposal landfill. Post action sampling and analyses of remaining subunit soils would be required to confirm the level of cleanup. After completion of the action, the site would be regraded and covered with 15 cm (6 in) of clean random fill. The total estimated present worth cost for this alternative is $2,131,000 (capital only, O&M costs are negligible).

2. Ephemeral Pool Soil

Alternative EPS-0: No Action. Evaluation of this alternative is required under CERCLA; it serves as a reference against which other alternatives can be compared. Under this alternative, no action would be taken to remove, treat, or contain contamination at this site and no institutional controls would be established to prevent exposure. There is no cost associated with this alternative.

Alternative EPS-1: Offsite Disposal. Approximately 250 m^3 (340 yd^3) of soil contaminated with PCB's above 1 mg/kg would be removed and disposed of. Front end loaders would be used for excavation and hauling would be by Department of Transportation (DOT) approved hazardous waste haulers. The contaminated material would be hauled in bulk. Material would be removed in phases with confirmatory testing conducted between each phase to verify that RAO's are met. At the completion of the action, the site would be regraded and covered with 15 cm (6 in) of clean random fill material. The total estimated present worth cost for this alternative is $356,000 (capital only, O&M costs are negligible).

Alternative EPS-2: Onsite Incineration. Onsite incineration would be accomplished by using a small mobile incinerator capable of processing approximately 4.5 metric tons (5-tons) of contaminated soil per day. There would be approximately 450 metric tons (490 tons) of soils contaminated with PCB's above 1 mg/kg to be processed. Combustion off gases would be treated to meet air quality standards for emissions through use of a secondary combustion chamber and wet scrubbers. Ashes would be quenched with water and the quench water would be recirculated. After incineration, the treated soil would be placed back at the operable subunit and the area would be regraded and covered with 15 cm (6 in) of clean topsoil. Materials would be excavated using standard equipment for earthwork. Confirmatory testing would be conducted to ensure that all contaminated soils above cleanup levels are removed. A 30.5-m (100-ft) graded square pad would be required to house the incinerator. The total estimated present worth cost for this alternative is $1,391,000 (includes capital and O&M costs).

Alternative EPS-3: Offsite Incineration. Approximately 450 metric tons (490 tons) of soils contaminated with PCB's would be excavated and shipped to an offsite incinerator. DOT-licensed hazardous waste haulers would carry the contaminated soils in bulk truck loads to a RCRA licensed facility. After incineration, the ash would be disposed of in this facility's ash disposal landfill. Confirmatory sampling and analyses of remaining soils would be required to confirm the level of cleanup. After completion of the action, the site would be regraded and covered with 15 cm (6 in) of clean random fill. The total estimated present worth cost for this alternative is $1,214,000 (capital only, O&M costs are negligible).

3. Horn Rapids Landfill

Alternative HRL-0: No Action. Evaluation of this alternative is required under CERCLA; it serves as a reference against which other alternatives can be compared. Under this alternative, no action would be taken to remove, treat, or contain contamination at this site and no institutional controls would be established to prevent exposure. There is no cost associated with this alternative.

Alternative HRL-1: Asbestos Cap. The first part of this alternative is removal and off-site disposal at a TSCA-permitted landfill of the area of soil known to be contaminated with PCB's above the MTCA C level of 5 mg/kg (approximately 226 m^3). Next, the asbestos cap would be constructed by placing 37,100 m^3 (48,500 yd^3) of clean random fill material over the 10.1 hectare (25 acre) site which is the area actively used as the landfill. Forty-five cm (18 in) of random fill material would be placed uniformly over the site following existing contours; no effort would be made to direct surface runoff off of the cap area. Placement of the first 15 cm (6 in) layer of this material would require the use of special construction practices to limit the exposure of remedial workers to fugitive dust. An additional 15 cm (6 in) topsoil layer would then be placed and seeded to dryland grasses. Total cap thickness would be 60 cm (2 ft). A notice will be placed on the deed to this property that identifies this as an asbestos-containing landfill. The total estimated present worth cost of this alternative is $2,634,000 (Capital $2,011,000 and O&M $41,000 for 30 years, discounted at 5%). The cost for removal and off-site disposal of the PCB-conataminated soil is $205,000.

Alternative HRL-2: Municipal Landfill Cap. The first part of this alternative is removal and off-site disposal at a TSCA-permitted landfill of the area of soil known to be contaminated with PCB's above 5 mg/kg (approximately 226 m^3). Next, the municipal landfill cap would be installed, consisting of a minimum of 15 cm (6 in) of topsoil over a geomembrane. The cap would be placed over the 10.1 hectare (25 acre) area, which is the extent of the actively used landfill. The cap would be designed to have a minimum 2-percent drainage slope to facilitate surface runoff. Because of the width of the landfill, intermediate drainage swales would be used to intercept this runoff. At these swales, perforated pipe would be used for surface drainage collection and the intercepted runoff would be carried past the extent of the cap into a drain field where it would be allowed to percolate through the vadose zone. The construction of the cap would require approximately 86,500 m^3 (113,000 yd^3) of random fill material to be used in preparing an adequately sloped subgrade. A geomembrane bedding layer would be placed on top of the random fill. Next, 87,900 m^2 (105,000 yd^3) of geomembrane would be placed and covered with 15 cm (6 in) of topsoil. The capped area would be reseeded to establish a vegetative cover and 1.83 km (6000 ft) of perimeter fence would be constructed to restrict access to the site. Appropriate warning signs would be posted to inform the public that the area is a past landfill site that contains asbestos material. The total estimated present worth cost of this alternative is $6,608,000

(Capital $5,445,000 and O&M $41,000 for 30 years, discounted at 5%). The cost for removal and off-site disposal of the PCB-conataminated soil is $205,000.

4. EM-2, EM-3, AND IU-1 Soil and Debris

Alternative OSS-0: No Action. Evaluation of this alternative is required under CERCLA; it serves as a reference against which other alternatives can be compared. Under this alternative, no action would be taken to remove, treat, or contain contamination at these sites and no institutional controls would be established to prevent exposure. There is no cost associated with this alternative.

Alternative OSS-1: Offsite Disposal. Under this alternative, underground storage tanks, pipes, sumps, and cisterns would be excavated, along with visibly stained or contaminated soils. Field sampling would be conducted during excavation to ensure that all contaminated soils are removed. All excavated materials would be stored onsite until they are transported and disposed of in accordance with applicable State and Federal requirements. All excavated areas would be back-filled with clean fill and revegetated to match surrounding topography. The estimated volume to be disposed is approximately 6000 yd^3. The estimated cost of this alternative is $4,455,000.

Alternative OSS-2: Onsite Incineration. Under this alternative, underground storage tanks, pipes, sumps, and cisterns would be excavated, along with visibly stained or contaminated soils. Field sampling would be conducted during excavation to ensure that all contaminated soils are removed. All excavated materials would be stored onsite until they are disposed of offsite or incinerated. Onsite incineration would be limited to contaminated soils, sediments, and small debris. Larger items such as tanks, piping, and demolition debris would be disposed of offsite. The incinerator residuals would be placed back into the excavated areas and covered with clean fill. All excavated areas would be back-filled with clean fill and revegetated to match surrounding topography. The estimated cost of this alternative is $7,974,000.

B. Groundwater Alternatives

Alternative GW-0: No Action. Evaluation of this alternative is required under CERCLA; it serves as a reference against which other alternatives can be compared. Under this alternative, no action would be taken to treat or contain contaminated groundwater and no institutional controls would be established to prevent exposure. There is no cost associated with this alternative.

Alternative GW-1: Natural Attenuation, Monitor, Evaluate Need for Further Action. Under this alternative, the groundwater contamination would be allowed to naturally attenuate. Groundwater monitoring and modelling have indicated that the TCE plume is expected to attenuate to levels below MCL's by the year 2017. Restrictions on the drilling of supply wells would be enforced during this period. Under this alternative, additional wells would be installed and regularly monitored along George Washington Way as a point of compliance. In the event that TCE concentrations exceed MCL's at the well sites, active groundwater remediation such as extraction and treatment would be evaluated. The total estimated present worth cost for this alternative is $1,059,000 (capital-$685,000; O&M-$24,300 discounted at 5% for 30 years).

Alternative GW-2A: Extraction and Treatment. TCE would be removed from contaminated groundwater by pumping groundwater through an air stripper. Air emissions from this process would contain low levels of TCE that are not expected to require additional treatment. The treatment system would operate at 100 gallons per minute (gpm). TCE levels in groundwater would be expected to reach MCL's by the year 2012. The total estimated present worth cost for this alternative is $5,111,000 (capital-$1,536,000; O&M-$256,300 discounted at 5% for 17 years).

Alternative GW-3A: Extraction and Treatment. This is the same treatment process as GW-2A. However, this system would operate at 300 gpm. TCE levels in groundwater would be expected to reach MCL's by the year 2008. The total estimated present worth cost for this alternative is $8,989,000 (capital-$3,557,000; O&M-$505,000 discounted at 5% for 13 years).

Alternative GW-2B: Extraction and Treatment. Extracted groundwater would be treated for TCE removal by a system consisting of a multimedia filter and an ultraviolet radiation/chemical oxidation treatment unit using ozone and hydrogen peroxide to destroy TCE. In this process, TCE is chemically destroyed and converted to carbon dioxide and water. The process would operate at 100 gpm and TCE levels in groundwater would be expected to reach MCL's by the year 2012. The total estimated present worth cost for this alternative is $5,714,000 (capital-$2,072,000; O&M-$262,000 discounted at 5% for 17 years).

Alternative GW-3B: Extraction and Treatment. This is the same treatment process as GW-2B. However, this system would operate at 300 gpm. TCE levels in groundwater would be expected to reach MCL's by the year 2008. The total estimated present worth cost for this alternative is $9,970,000 (capital-$4,228,000; O&M-$538,000 discounted at 5% for 13 years).

IX. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section summarizes the relative performance of each of the alternatives with respect to the nine criteria identified in the NCP. These criteria fall into three categories: The first two (Overall Protection of Human Health and the Environment and Compliance with ARAR's) are considered threshold criteria and must be met. The next five are considered balancing criteria and are used to compare technical and cost aspects of alternatives. The final two criteria (State and Community Acceptance) are considered modifying criteria. Modifications to remedial actions may be made based upon state and local comments and concerns. These were evaluated after all public comments were received.

A. Threshold Criteria

1. Overall Protection of Human Health and the Environment

Overall Protection of Human Health and the Environment addresses whether or not a remedy provides adequate protection and describes how risks posed through each pathway are eliminated, reduced, or controlled through treatment, engineering controls, or institutional controls.

All of the alternatives, except the no action alternatives (DSS-0, EPS-0, HRL-0, OSS-0, and GW-0) would provide some protection of human health and the environment. DSS-3 is protective because it removes and treats the contaminated soils at the Discolored Soil Site. Alternative EPS-1 is protective because it removes and properly disposes of the contaminated soils at the Ephemeral Pool. Exposure to asbestos (the principal threat) at the Landfill would be prevented by providing an asbestos-landfill cap (Alternative HRL-1) to contain the soils by preventing windblown dust. Alternative GW-1 prevents exposure to contaminated groundwater while the contamination attenuates to levels that do not pose undue risks.

Alternative DSS-1 would reduce the levels of BEHP, but it may not be completely successful because the technology is unproven beyond laboratory-scale tests. Alternative DSS-2, EPS-2, and EPS-3 would be fully protective of human health and the environment because these alternatives would destroy the contaminants at the sites. Alternative HRL-2 would also prevent exposure to asbestos. Groundwater Alternatives GW-2A, GW-2B, GW-3A, and GW-3B would be protective by preventing exposure and would also utilize groundwater extraction and treatment for some acceleration of cleanup.

Alternatives OSS-1 and OSS-2 would meet the remedial action objectives. For Alternative OSS-1, protection of human health would be provided by reducing the risks through removal and offsite disposal. Alternative OSS-2 would achieve protection through incineration.

2. Compliance with ARAR's

Compliance with ARAR's addresses whether a remedy will meet all of the applicable or relevant and appropriate requirements (ARAR's) of other Federal and State environmental laws and/or justifies a waiver.

Soil alternatives DSS-2, DSS-3, EPS-1, EPS-2, EPS-3, HRL-1, HRL-2, OSS-1, and OSS-2 can meet all identified ARAR's. Alternative DSS-1 may not be efficient enough to meet cleanup levels without additional controls (e.g. institutional controls and/or capping). The "No Action" alternatives do not comply with ARAr's. Groundwater alternatives GW-1, GW-2A, GW-2B, GW-3A, and GW-3B would achieve ARAR's, although the timeframes vary from 16 years to 25 years.

B. Primary Balancing Criteria

Because the "No Action" alternatives are not protective of human health and the environment and do not comply with ARAR's, they are not considered further.

3. Long-Term Effectiveness and Permanence

Long-Term Effectiveness and Permanence refers to the magnitude of residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time once cleanup goals have been met.

Alternatives DSS-2, DSS-3, EPS-2, EPS-3, and OSS-2 have the highest degrees of effectiveness and permanence because they employ incineration to destroy the contaminants. Alternative DSS-1 would be permanent, but the technology is unproven beyond laboratory-scale tests. Both HRL-1 and HRL-2 will be effective for the life of the caps. The estimated useful life of landfill caps is 30 to 50 years. In practice, the useful life of the asbestos cap could be much longer depending on site conditions and use. Alternative OSS-1 has a high degree of long-term permanence because contaminants are removed offsite to a controlled facility. All of the groundwater alternatives would be expected to provide long-term effectiveness once cleanup goals are attained. As noted above, the timeframes to achieve cleanup goals vary.

4. Reduction of Toxicity, Mobility, or Volume through Treatment or Recycling

Reduction of Toxicity, Mobility, or Volume through treatment is the anticipated performance of the treatment technologies that may be employed in a remedy.

Soil Alternatives DSS-2, DSS-3, EPS-2, EPS-3, and OSS-2 utilize treatment to reduce contaminant volume, mobility, and toxicity. Alternative DSS-1 also utilizes treatment, but as previously described, the degree of reduction is unproven. Groundwater Alternatives GW-2A, GW-2B, GW-3A, and GW-3B all employ technologies that would reduce mobility and volume. Groundwater Alternatives GW-2B and GW-3B also reduce TCE toxicity by destroying the TCE.

5. Short-Term Effectiveness

Short-Term Effectiveness refers to the speed with which the remedy achieves protection, as well as the remedy's potential to create adverse impacts on human health and the environment during the construction and implementation period.

All of the soil alternatives would create some level of short-term risk until the actions are completed, however workers and nearby residents would be protected during site activities by engineered and administrative controls. The actions described in soil alternatives DSS-2, DSS-3, EPS-1, EPS-2, EPS-3, HRL-1, HRL-2, and OSS-1 could be completed within a 6 to 9 month timeframe. Alternative DSS-1, due to the uncertainties associated with bioremediation, and Alternative HRL-2, which requires specialized equipment to install the synthetic liner, would take longer to complete. Alternative OSS-2 would take 1 to 2 years to implement. Alternatives GW-3A and GW-3B would achieve cleanup goals in the shortest timeframe (approximately 16 years). Emissions from the air stripper used in GW-2A and GW-3A are relatively low and should not require additional treatment. Neither the active nor passive alternatives pose any undue risks for implementation.

6. Implementability

Implementability is the technical and administrative feasibility of a remedy, including the availability of materials and services needed to implement the solution.

All of the soil alternatives can be implemented, although with varying degrees of difficulty. Mobilizing an onsite incinerator (required for DSS-2, EPS-2, and OSS-2) poses additional difficulties. The bioremediation option (DSS-1) would require treatability testing prior to implementation. All groundwater alternatives are readily implementable.

7. Cost

Cost includes capital and operation and maintenance costs. The estimated costs are present worth costs (capital costs plus annual costs over the life of the project, with a 5% discount rate).

The estimated costs of the Discolored Soil Site alternatives range from $997,000 to $2,131,000.

The estimated costs of the Ephemeral Pool alternatives range from $356,000 to $1,391,000.

The estimated costs of the Horn Rapids Landfill alternatives range from $2,839,000 to $6,813,000.

Alternative OSS-1, Offsite Disposal, is estimated to cost $4,455,000, while Alternative OSS-2, Onsite Incineration, is estimated to cost $7,974,000.

The estimated costs of the groundwater alternatives range from $1,059,000 to $9,970,000.

C. Modifying Criteria

8. State Acceptance

State Acceptance indicates whether, based on its review of the Final RI/FS Report and Proposed Plan, the State concurs with, opposes, or has no comment on the preferred alternative.

The Washington State Department of Ecology concurs with the selection of the final remedial alternative described in this ROD. Ecology has been involved with the development and review of the Remedial Investigation, Feasibility Study, Proposed Plan, and Record of Decision. Ecology comments have resulted in significant changes to these documents and has been integrally involved in determining which cleanup standards apply under MTCA.

9. Community Acceptance

Community Acceptance refers to the public's support for the preferred remedial alternative and is assessed following a review of the public comments received on the Final RI/FS Report and the Proposed Plan.

On June 30, 1993, a public meeting was held to discuss the Proposed Plan for the 1100 Area. The results of the public meeting and the public comment period indicates acceptance of the preferred remedial alternative, with some exceptions, one of which resulted in a minor deviation from the proposed plan. Community response to the remedial alternatives is presented in the responsiveness summary, which addresses questions and comments received during the public comment period.

X. SELECTED REMEDY

The selected remedy for the 1100 Area NPL Site includes Offsite Incineration of BEHP-Contaminated Soils at the Discolored Soil Site (Alternative DSS-3), Offsite Disposal of PCB-Contaminated Soils at the Ephemeral Pool (Alternative EPS-1), an Asbestos Cap at the HRL (Alternative HRL-1), and Offsite Disposal of Contaminated Soil and Debris from the 1100-EM-2, 1100-EM-3, and 1100-IU-1 Operable Units (Alternative OSS-1). The selected remedy also includes Natural Attenuation and Groundwater Monitoring for Compliance with MCL's (Alternative GW-1). Table 23 summarizes the risk reduction of the selected remedy.

Of the nine criteria described above, the criteria which weighed heavily in the decision are Long-Term Effectiveness, Implementability, and Cost. The components of the selected remedy achieve the best balance of these three criteria. Among the DSS alternatives, Alternative DSS-3 provides for the highest level of long-term effectiveness and implementability, but it does have the highest cost. Alternative EPS-1 has a lesser degree of

Table 23. Summary of the Selected Alternative

	Current Risk	Selected Remedy	Risk After Remediation	Cost
Discolored Soil Site	2×10^{-3}	Offsite Incineration	2×10^{-6}	$2,131,000
Ephemeral Pool	1×10^{-3}	Offsite Disposal	3×10^{-5}	$356,000
Horn Rapids Landfill	7×10^{-5}	Asbestos Landfill Closure	8×10^{-6}	$2,839,000
Groundwater	3×10^{-5}	Natural Attenuation with continued monitoring	2×10^{-6}	$1,059,000
Contaminated Soil and Debris from EM-2, EM-3, and IU-1	$>10^{-5}$[a]	Offsite Disposal	$<10^{-5}$[a]	$4,455,000

[a] Assessment is qualitative

long-term effectiveness than the other EPS alternatives, but it is very implementable and has the lowest cost. The asbestos cap for the Horn Rapids Landfill (Alternative HRL-1) has the better long-term effectiveness, implementability, and the lowest cost of the HRL alternatives. Alternative OSS-1 has the lowest cost and better implementability, although the long-term effectiveness may be slightly less. The groundwater alternatives are approximately equal in terms of long-term effectiveness and implementability, but GW-1 has a significantly lower cost.

The total estimated costs of the remedy are $10,840,000. The preliminary design considerations described in this ROD are for cost estimating and are subject to change based on the final remedial design and construction practices.

A. Offsite Incineration BEHP-Contaminated Soils

Soil from the Discolored Soil Site which is contaminated with BEHP above the MTCA cleanup level of 71 mg/kg will be removed and transported to a permitted, offsite incinerator. After incineration, the residuals will be disposed of in that facility's ash disposal landfill. This will prevent exposure to soils contaminated with BEHP above the cleanup level. The approximate volume to be excavated is 100 cubic meters (130 cubic yards). During the excavation, samples will be taken to monitor progress. Confirmation samples will also be taken to verify that cleanup levels have been met. The site will be re-graded.

B. Offsite Disposal of PCB-Contaminated Soils

Ephemeral Pool Soils contaminated with PCB's above the MTCA cleanup level of 1 mg/kg will be removed and properly disposed of at a TSCA-permitted, offsite landfill. This will prevent exposure to soil containing PCB's above the cleanup level. The estimated volume is 125 cubic meters (165 cubic yards). Confirmatory sampling will be performed to verify that the cleanup level is met.

C. Asbestos Cap

The Horn Rapids Landfill will be closed as an Asbestos Landfill in accordance with the Asbestos NESHAP (40 CFR 61.151). This will prevent exposure to asbestos-containing dusts. Prior to installation of the cap, a localized area of soil that is contaminated with PCB's will be removed. This area is centered around a vadose zone borehole in the Horn Rapids Landfill (borehole HRL-4). Approximately 226 cubic meters (296 cubic yards) of soil contaminated with PCB's above 5 mg/kg will be removed and transported to a TSCA-permitted, offsite landfill. Both field monitoring and confirmatory sampling will be performed to ensure that the 5 mg/kg level is met.

D. Offsite Disposal of Contaminated Soil and Debris

Soil and debris from the sites in the 1100-EM-2, 1100-EM-3, and 1100-IU-1 Operable Units (from Table 5-1 from Volume IV of the RI/FS Report) which are contaminated above the levels in Table 19 will be removed and disposed in a permitted offsite landfill. Field monitoring will be performed during excavation and then samples will be taken and analyzed to confirm that the cleanup levels have been met.

E. Natural Attenuation and Groundwater Monitoring

Continued groundwater monitoring is necessary to verify modeled predictions of contaminant attenuation and to evaluate the need for active remedial measures.

The monitoring system will be designed and optimized to confirm that attenuation is occurring. The monitoring frequency will be selected to ensure that achievement of the RAO's can be verified. If monitoring does not confirm the predicted decrease of contaminant levels as estimated in the RI/FS, DOE, EPA, and Ecology will evaluate the need to perform additional response actions.

Approximately six groundwater monitoring wells will be used to determine when the Remedial Action Objectives have been attained and to evaluate the need for further actions. The wells will be sampled periodically. In addition to TCE and nitrate, the monitoring program will at a minimum analyze for vinyl chloride and 1,1-dichloroethene, since these compounds are breakdown products of TCE. Specific criteria for compliance monitoring and decision-making will be developed during the remedial design.

F. Implementing Institutional Controls

Institutional controls will also be included as part of the selected remedy. DOE will control access and use of the site for the duration of the cleanup, including restrictions on the drilling of new groundwater wells in the plume or its path will be enforced until the Remedial Action Objectives have been attained. In addition, DOE will record a notation on the deed to the Horn Rapids Landfill property as specified in the asbestos NESHAP (40 CFR 61).

XI. STATUTORY DETERMINATIONS

Under CERCLA Section 121, selected remedies must be protective of human health and the environment, comply with ARAR's, be cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practical. In addition, CERCLA includes a preference for remedies that employ treatment that significantly and permanently reduces the volume, toxicity, or mobility of hazardous wastes as their principal element. The following sections discuss how the selected remedy meets these statutory requirements.

A. Protection of Human Health and the Environment

The selected remedy protects human health and the environment through soil and groundwater actions. Implementation of this remedial action will not pose unacceptable short-term risks toward site workers. Installation of the asbestos cap will prevent dispersion of the asbestos. Removal of contaminated soil will similarly prevent exposure. The groundwater controls will prevent exposure to contaminated groundwater.

The baseline risk assessment for a residential scenario associated with this site estimated a cumulative risk of 4×10^{-3}. The residual risks after this remedy is estimated at 3×10^{-5} (residential scenario).

B. Compliance with ARAR's

The selected remedy will comply with the federal and state ARAR's identified below. No waiver of any ARAR is being sought. The ARAR's (identified in the RI/FS) for the 1100 Area are the following:

Chemical-Specific ARAR's

- Safe Drinking Water Act (SDWA), 40 USC Section 300, Maximum Contaminant Levels (MCL's) for public drinking water supplies are relevant and appropriate for setting groundwater cleanup levels.

- Model Toxics Control Act Cleanup Regulations (MTCA), Chapter 173-340 WAC, Method A, Method B, and Method C risk-based cleanup levels are applicable for establishing soil cleanup levels.

Action-Specific ARAR's

- Hazardous Materials Transportation Act (49 USC 1801-1813), Applicable for transportation of potentially hazardous materials, including samples and wastes.

- National Emission Standards for Hazardous Air Pollutants (NESHAP), (40 CFR 61), relevant and appropriate for closure requirements in relation to the Horn Rapids Landfill.

- RCRA Land Disposal Restrictrictions (40 CFR 268) are applicable for off-site disposal of BEHP-contaminated soils.

- Minimum Standards for Construction and Maintenance of Wells (Chapter 173-160 and 162 WAC) Applicable regulations for the location, design, construction, and abandonment of water supply and resource protection wells.

- RCRA Subtitle C (40 CFR 262) establishes standards for generators of hazardous wastes for the treating, storage, and shipping of wastes. Applicable to the transportation of hazardous wastes including the BEHP-contaminated soils.

Location-Specific ARAR's

- National Historic Preservation Act (16 CFR 470, *et. seq.)*

- Endangered Species Act (40 CFR 402)

Other Criteria, Advisories, or Guidance to be Considered for this Remedial Action (TBC's)

- EPA OSWER 9834.11, Revised Procedures for Planning and Implementing Off-Site Response Actions, November 13, 1987. This directive provides procedures for off-site disposal of CERCLA wastes.

- The Future For Hanford: Uses and Cleanup, The Final Report of the Hanfrod Future Site Uses Working Group, December 1992.

C. Cost Effectiveness

The selected remedy provides overall effectiveness proportional to its cost. The cost for Offsite Incineration of the BEHP-contaminated soil at the Discolored Soil Site appears to be higher than for the other alternatives, but the other alternatives may not comply with the land disposal restrictions.

D. Utilization of Permanent Solutions and Alternative Treatment Technologies to the Maximum Extent Possible

The selected remedy utilizes permanent solutions and alternative treatment technologies practicable for this site. Treatment was identified for the BEHP-contaminated soils at the Discolored Soil Site. No other forms of practicable treatment were identified.

E. Preference for Treatment as a Principal Element

The selected remedy utilizes treatment which permanently destroys the BEHP in the soil. The timeframe to achieve MCL's in groundwater via the selected remedy is approximately 25 years, which is longer than the timeframes (16 to 20 years) for remediation under Alternatives GW-2A, GW-2B, GW-3A, and GW-3B. Because this groundwater is not used as a drinking water source, there are no current potential risks to human health. When considered against the other balancing criteria, the potential reduction in time (5 to 9 years) for the groundwater treatment alternatives is not sufficient to offset the additional costs ($4,000,000 to $8,000,000).

XII. DOCUMENTATION OF SIGNIFICANT CHANGES

DOE and EPA reviewed all written and verbal comments submitted during the public comment period. Upon review of these comments, it was determined that no significant changes to the selected remedy, as originally identified in the Proposed Plan, were necessary.

Although not a significant change, the cleanup level for the PCB-contaminated soil in the Horn Rapids Landfill was lowered to 5 ppm from 50 ppm. This change results in an estimated additional 265 cubic yards of soil being removed and was based largely on a comment received during the public comment period.

RESPONSIVENESS SUMMARY

USDOE HANFORD 1100 AREA

RESPONSIVENESS SUMMARY

The U.S. Department of Energy (DOE), the U.S. Environmental protection Agency (EPA) and the State of Washington, Department of Ecology (Ecology), (the agencies) held a public comment period from May 24, 1993 through July 9, 1993 for interested parties to comment on the 1100 Area Proposed Plan. The Plan presents the preferred alternatives for waste management units in the four 1100 Area operable units. The primary supporting documents include the 1100 Area Draft Remedial Investigation/Feasibility Study (Draft C) for the 1100-EM-1 Operable Unit and the Draft Limited Field Investigation/Focused Feasibility Study (LFI/FFS) (Draft B) for 1100-EM-2, 1100-EM-3 and the 1100-IU-1 Operable Units.

A public meeting was held on June 30, 1993 at the Richland Public Library, 955 Northgate Drive in Richland, Washington to describe the remedial technologies that were evaluated and to present the agencies preferred alternatives for the 1100 area operable units.

A responsiveness summary is required by the Comprehensive Environmental Restoration Compensation and Liability Act (CERCLA), for the purpose of providing the agencies and the public with a summary of citizens comments and concerns about the site, as raised during the public comment period, and the agencies' response to those comments and concerns.

I. RESPONSIVENESS SUMMARY OVERVIEW. This section briefly describes the background of the Hanford Site 1100 Area and outlines the preferred alternatives for the 1100 Area Operable Units.

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS. This section provides a brief history of community interest and concerns regarding the 1100 Area Operable Units.

III. SUMMARY OF MAJOR QUESTIONS AND COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND THE AGENCIES' RESPONSES TO THOSE COMMENTS. This section summarizes both oral and written comments submitted to the agencies at the public meeting and the public comment period, and provides the agencies' responses to those comments.

IV. REMAINING CONCERNS. This section discusses community concerns that the agencies should be aware of as they prepare to undertake remedial designs and remedial actions at the 1100 Area Operable Units.

I. RESPONSIVENESS SUMMARY OVERVIEW

SITE BACKGROUND

The 1100 Area Superfund Site, placed on the National Priority List in July 1989, includes four "operable units": 1100-EM-1, 1100-EM-2, 1100-EM-3, and 1100-IU-1. An operable unit is a grouping of individual waste units based primarily on geographic area and common waste sources. For the remainder of this Plan, the "1100-" prefix will be dropped when referring to the operable units (e.g. 1100-EM-1 will be referred to as EM-1). EM-1 was assigned the highest priority among the Hanford operable units due to its close proximity to the North Richland well field. The RI/FS activities at EM-1 were initiated in 1989, and the Phase I RI/FS was completed in August 1990. In the fall of 1992, EPA, DOE, and Ecology decided to accelerate the study and evaluation of the other three operable units so that all remedial actions in the 1100 Area could proceed as a single project. In place of extensive field investigations, EM-2, EM-3, and IU-1 were evaluated by analysis of existing waste information, detailed visual inspections and through interviews with site personnel. Since the EM-1 investigation was nearly complete at the time of the decision, the results from the evaluation of EM-2, EM-3, and IU-1 are contained in an addendum to the EM-1 RI/FS Report.

EM-1

EM-1 contains the central warehousing, vehicle maintenance, and transportation distribution center for the entire Hanford Site. Additionally, the Horn Rapids Landfill is located in the northern portion of EM-1. A wide range of materials and potential waste products were routinely used at and near EM-1.

The RI/FS investigated seven areas and determined that three areas within EM-1 contained contaminants at levels that may pose potential long-term risks to human health. A description of each of these three areas and the contamination is provided below. A summary of contaminants of concern and potential risks for EM-1 is presented in Table 1. In addition, Table 2 presents the cleanup goals and the remaining risks once the cleanup goals are met.

- **Discolored Soil Site (DSS)**. At this site, bis(2-ethylhexyl)phthalate (BEHP) was spilled, resulting in the known contamination of approximately 100 cubic meters (130 cubic yards) of soil, and potentially up to 340 cubic meters (440 cubic yards). Cleanup cost estimates were developed using the higher volume. BEHP is a probable human carcinogen and when ingested in large doses, may cause other adverse health effects.

- **Ephemeral Pool (EPS)**. This is an elongated depression adjacent to a parking area where runoff water collects and evaporates. Polychlorinated biphenyls (PCB's) from an unknown release at this site have contaminated approximately 125 cubic meters (165 cubic yards) of soil, and potentially up to 250 cubic meters (340 cubic yards). Cleanup cost estimates were developed using the higher volume. PCB's are probable human carcinogens.

- **The Horn Rapids Landfill (the Landfill).** A landfill that was used primarily for the disposal of office and construction waste, asbestos, sewage sludge, and fly ash. Extensive investigations did not find any drums of organic liquids, which were alleged to have been disposed at the Landfill. Contaminants of concern are the asbestos distributed throughout the landfill, as well as approximately 460 cubic meters (600 cubic yards) of PCB-contaminated soils.

- **Groundwater.** Trichloroethylene (TCE) contaminated groundwater is found both upgradient and downgradient of the Landfill. Monitoring data indicates that the TCE contamination is the result of a single or limited spill. TCE has been listed as a probable human carcinogen, although that classification is under review. The TCE plume is approximately 1.6 kilometers (1 mile) long and 0.3 kilometers (0.2 miles) wide, and is moving in a northeasterly direction. In addition, the groundwater monitoring network for the Landfill has detected nitrates and Technetium-99 (a radionuclide). These concentrations result in low risk levels which would not trigger remedial action. A review of all available information indicates that contamination has moved onto the Site via the groundwater. An adjacent facility is investigating soil and groundwater contamination in accordance with the Washington State Model Toxics Control Act.

<u>EM-2, EM-3, AND IU-1</u>

The EM-2 and EM-3 operable units are adjacent to EM-1 and also contain facilities supporting warehousing and vehicle maintenance activities. Eighteen waste sites within EM-2 and EM-3 were identified as candidates for remedial actions. IU-1 consists of a former NIKE Missile Base and Control Center on Rattlesnake Mountain. Thirty-two waste sites were identified within IU-1 as potential candidates for remedial actions. In all three operable units, the waste sites primarily consist of tanks that were used for fuel and chemical solvent storage, transformers and pads, spills and disposal areas.

The groundwater information currently available for EM-2, EM-3, and IU-1 indicates the presence of nitrates in groundwater beneath EM-3 and naturally-occurring high levels of fluoride at IU-1.

Summary of EM-1 Preferred Alternative

<u>SOILS</u>

Discolored Soils Site

Alternative DSS-3: Offsite Incineration. Under this alternative, the BEHP-contaminated soils would be excavated, transported by a licensed hazardous waste hauler, and treated at a permitted incinerator; the ash would be disposed of in an offsite, permitted landfill. The excavated area would be back-filled with clean fill. The total estimated cost for this alternative is $2,131,000.

Ephemeral Pool Soil

Alternative EPS-1: Offsite Disposal. The Ephemeral Pool soils contaminated with PCB's above 1 ppm would be excavated, transported by a licensed waste hauler, and disposed of in a permitted facility. The excavated area would be regraded and back-filled with clean soil. The total estimated cost for this alternative is $356,000.

Horn Rapids Landfill

Alternative HRL-1: Asbestos Cap. The Landfill would be capped with 60 centimeters (2 feet) of clean soil to meet federal requirements for capping inactive landfills containing asbestos. The total estimated cost with this alternative is $2,011,000. Additional estimated cost associated with disposal of approximately 23 cubic meters (30 cubic yards) of soils with PCB's greater than 50 ppm is $95,000 for offsite disposal.

EM-1 GROUNDWATER

Alternative GW-1: Natural Attenuation, Monitor, Evaluate Need for Further Action. Under this alternative the groundwater contamination would be allowed to naturally attenuate. Groundwater monitoring and modelling have indicated that the TCE plume is expected to attenuate to levels below MCL's by the year 2017. Well restrictions would be enforced during this period. Under this alternative, additional wells would be installed and regularly monitored along George Washington Way as an early warning system. In the event that TCE concentrations exceed MCL's at the well sites, active groundwater remediation such as extraction and treatment would be evaluated. The total estimated cost for this alternative is $1,059,000.

Summary of EM-2, EM-3, and IU-1 Preferred Alternative

EM-2, EM-3, AND IU-1 SOIL AND DEBRIS

In all three operable units, the waste sites primarily consist of tanks that were used for fuel and chemical solvent storage, transformers and pads, spills and disposal areas.

Alternative OSS-1: Offsite Disposal. Under this alternative, the activities listed as common elements would be implemented, then contaminated materials would be transported and disposed of in accordance with applicable State and Federal requirements. The estimated cost of this alternative is $4,455,000

II. BACKGROUND ON COMMUNITY INVOLVEMENT AND CONCERNS.

The 1100-EM-1 Operable Unit was designated as the highest priority for investigation and remediation due to proximity to the City of Richland North Wellfield. The concern was raised that in the event contaminants had been released into the soil at the 1100-EM-1, there could be a potential for adverse impacts to the wellfield. The results of remedial investigations have indicated low levels of TCE is present in groundwater at 1100-EM-1. The TCE plume is not in proximity to the wellfield. Furthermore, the low levels of TCE contamination are migrating away from the wellfield into an area where groundwater is not used for drinking water.

The 1100-EM-2 and 1100-EM-3 are immediately adjacent to the 1100-EM-1 and expected to eventually be turned over to the City of Richland. The current city master plan projects those areas as likely places for continued light industrial/commercial development. The has been active interest on the part of the local community to accelerate cleanup in order to facilitate future growth in those areas.

The 1100-IU-1 is contained entirely within the Arid Lands Ecological Reserve (ALE). The ALE has been designated as an area for cleanup by October 1994, per an Agreement In principle signed by DOE, EPA and Ecology in March, 1993. Expedited cleanup of the 1100-IU-1 will facilitate the eventual release of the approximately 125 square mile area by DOE. The recipient and/or future administrators of the ALE have not been decided at this time.

III. SUMMARY OF MAJOR QUESTIONS AND COMMENTS RECEIVED DURING THE PUBLIC COMMENT PERIOD AND THE AGENCIES' RESPONSES TO THOSE COMMENTS.

Significant comments received during the public comment are presented in this section verbatim. Responses to the comments follow each comment. Numerous comments were received that were not related to the 1100 Area Operable Units. Copies of all comment letters that were received are attached to this responsiveness summary as Appendix A. Throughout the responses to the comments, Volume I through IV of the April 1, 1993 RI/FS DOE/RL-92-67 are referenced. In some cases other DOE documents are referred to by catalog number. When a catalog number is not referenced, DOE/RL-92-67 is the document that is cited.

A transcript of the public meeting was made and is available for review at the Information Repositories.

COMMENT 1. The RI/FS was to consider the 1100-EM-1 Operable Unit only. Now the 1100-EM-2; 1100-EM-3; and 1100-IU-1 Operable Units were thrown in the 1100 area matrix. The RI/FS and the LFI/FFS should clearly indicate that these are two separate Field Studies. One complies with CERCLA, and Clean Water Act; while the other (LFI/FFS) is merely a scoping or proposed plan process to assist in an RI/FS. The LFI/FFS does not satisfy the legal requirements of Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) as referred to in the National Oil and Hazardous Materials Contingency Plan, (NCP). 45 CFR 300 et. seq.

RESPONSE: An overview of the organization and presentation of the information developed for evaluating the 1100-EM-1 Operable Unit and the 1100-EM-2, 1100-EM-3 and 1100-IU-1 Operable Units is clearly presented in the executive summary sections of Volume I and Volume IV, respectively. The Limited Field Investigation/Focused Feasibility Study (LFI/FFS) approach taken for the latter three operable units (OU's) is not "merely a scoping process to assist in an RI/FS." The LFI/FFS approach is consistent with section 300.430 of the National Contingency Plan (NCP) where it is stated that..."The development and evaluation of alternatives shall reflect the scope and complexity of the remedial action under consideration and the site problems being addressed."

COMMENT 2. We note that the addendum or LFI/FFS included the Rattlesnake Mountain (1100-IU-1). The initial RI/FS did not include nor did it mention Rattlesnake Mountain. The LFI/FFS did not explain why this was included--clearly this area is on the Arid Lands Ecology--nor does it state whether this is on the National priorities list. This did not allow the Trustees to comment on that area prior to the RI/FS going public. We recommend that the trustees be given the initial opportunity to comment with regards to the

1100-IU-1, (Rattlesnake Mountain area); 1100-EM-2; 1100-EM-3; 1100-IU-1 Operable Units.

RESPONSE: On pages ES-1 and 1-1 of Volume IV of the 1100 Area RI/FS it is stated that 1100-IU-1 is one of four 1100 Area CERCLA Operable Units associated with the 1100 Hanford National Priorities Listing. The 1100-IU-1 consists of the former NIKE Missile Base and Control Center, both of which are located at Rattlesnake Mountain. it does not include the entire Rattlesnake Mountain, rather only those areas that may have been affect by a release or releases of hazardous substances at the 1100-IU-1. The Executive Summary of Draft B of the 1100 Area RI/FS discusses the streamlined approach that was being undertaken for the other three 1100 Area Operable Units. That version was distributed to the Trustees in December 1992.

COMMENT 3. We view the LFI/FFS process as an innovative technique to circumvent the procedural hoops that the lead agency must hurdle in order to legally comply with the requirements of CERCLA. It is not clear nor is it mentioned in the RI/FS or the addendum (LFI/FFS) why an LFI/FFS was prepared on the 1100-EM-2; 1100-EM-3; 1100-IU-1 Operable Units.

RESPONSE: As noted above, the approach taken for the 1100-EM-2, 1100-EM-3 and 1100-IU-1 Operable Units is not inconsistent with the NCP. Furthermore, as noted above, there are discussions in both the December 1992 and the April 1993 releases of the 1100 RI/FS documents regarding the approach that was being undertaken for the 1100 Area operable units.

COMMENT 4. We recommend, in preparing an RI/FS, that it should also include the cumulative contamination from the surrounding areas of the 1100 area (except 1100-IU-1). see page 3. infra.

RESPONSE: The commentor is referred to previous published volumes of the RI/FS reports that contain additional information regarding site conditions. As noted on Page 1-2 of Volume I of the 1100 Area RI/FS "Familiarity with previous investigative reports published on the 1100 Area, especially as presented in DOE/RL-90-18 and DOE/RL-90-32 is assumed for a <u>critical</u> review of the findings and recommendations presented in this document."

COMMENT 5. The 1100 area has been placed on the National Priorities list due to the concern for the proximity of the Richland drinking wells to the contamination. The report mentioned nitrates, trichloroethene (TCE), and some radiation in the groundwater. The report should indicate whether the 1100 area continues to be on the National Priorities list now that the concerns over contamination near the drinking water are dispelled. The emphasis was on health and safety concerns. However the report does not indicate whether the contamination continues to be an environmental risk to the fauna or flora.

RESPONSE: The 1100 Area continues to be on the National Priorities List. The Administrative procedures and legal requirements for NPL deletion can be found in the NCP at 300.425; and in OSWER Directive 9320.2-3A Procedures for Completion and Deletion and Five Year Reviews for Sites on the National Priorities List.

In Volume I, Section 5.3 Summary Of Ecological Risk Assessment For The 1100-EM-1 Operable Unit it is noted that... "Using highly conservative assumptions and models, no uptake rates for the long-billed curlew or the Swainson's hawk exceeded toxicity values." It is also noted that "Even though there are significant uncertainties in this assessment, there has been little evidence of ecological damage at the site."

COMMENT 6. EPA is the lead agency for this RI/FS, the consideration of the implementation of new technology and the trained personnel for that new technology must be part of the RI/FS process. We note that the report will not consider new technology in the remediation process. This is contrary to expressed direction to EPA under 45 CFR 300.400(a) (E).

RESPONSE: As a point of clarification, the U.S. Department of Energy is the lead agency for the 1100 Area RI/FS activities. The NCP 300.430(a)(E) states that... "EPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, fewer or lesser adverse impacts than other available approaches, or lower costs for similar levels of performance than demonstrated technologies." New technologies were evaluated during the course of the RI/FS, including the bioremediation of soils contaminated with polychlorinated biphenyls (PCBs) and bis (2-ethylhexyl)phthalate (BEHP) and bench scale testing of supercritical fluid extraction for removal of PCBs and BEHP from contaminated soils at the Discolored Soils Site. A review of literature showed that there has been limited success in bioremediating PCBs in bench scale studies, specifically Aroclor 1242. No documented studies indicating that bioremediation of Aroclors 1248 and 1260 (those found at the Horn Rapids Landfill and the Ephemeral Pool sites) was found. Moreover, biodegradation of PCB contaminated soils in the field has not been successful to date. For these reasons bioremediation of PCBs as a viable alternative was not pursued. Only one case of successful bioremediation of BEHP contaminated soils was found. There was evidence to suggest that dilution by mixing was a contributor to achieving this sites cleanup goals. Even if removal efficiencies approached 99%, the MTCA cleanup goal for the Discolored Soil Site could not be achieved based on the 95% UCL concentration. Because of these uncertainties, and because the volume of BEHP contaminated soil is small (estimated from 130 to 440 cubic yards), a more proven technology was chosen.

Bench scale studies of supercritical fluid extraction provided promising results with removal efficiencies of 97% and 99% for BEHP and PCBs respectively. Again, MTCA cleanup standards would not be achieved. Due to uncertainties associated with the ability of the technology to achieve cleanup goals, as well as the lack of full scale equipment for implementation, that technology was not identified as a preferred alternative. This analysis and ultimate recommendation is consistent with the expectations discussed in the NCP as noted above. However, due to the encouraging results from the bench scale studies conducted on the soils from this OU, DOE will continue to pursue the development of this technology for other OU's at Hanford which may entail larger volumes of contaminated soils.

COMMENT 7. There was little to no mention in the report about what the natural landscape was before DOE development. The report should state and list the current vegetation in the area where applicable. Further, some of the areas designated for remediation and "capping: should include the design and types of vegetation that will be used in that process. Sandburg's bluegrass (Poa sandburgii) and Indian Rice Grass (Oryzopsis hymenoides) are excellent grasses for cover as they are native to the area and have short roots favorable for capping. Further, Sandburg's bluegrass has the ability to compete with cheat grass.

RESPONSE: As noted in the response to Comment 4 above, additional information was presented in previously published 1100 Area documents. The commentor is directed to DOE/RL-90-18, Section 3.7.2.1 Terrestrial Ecology and DOE/RL-92-67 Appendix L for information regarding vegetation in the 1100-EM-1. Information on vegetation in the other 1100 Area can be found in Volume IV Section 1.5.4 Ecological Features. These sections of the above mentioned reports also contain additional references of previous on-site studies of terrestrial ecosystems. The use of the grasses mentioned in this comment will be considered during remedial design.

COMMENT 8. For 50+ years, the YIN has been deprived of use and access to the Hanford reservation, the report should include Natural Resource Damage Assessments on the 1100 area to determine what usage and access has been lost or restricted.

RESPONSE: DOE as lead trustee for the Hanford site intends to use the RI/FS and associated Ecological assessment for certain Natural Resource Damage Assessment activities. As noted on page 1-3 of Volume I,..."This RI/FS with its Ecological Assessment and analysis of alternatives is to be used by DOE in lieu of a Preassessment Screen for Natural Resources Damages Assessment (43 CFR 11)."

COMMENT 9. Another question that continued to be raised during the review process of this RI/FS was a shortage of investigative teams to check the contents of the barrels and other anomalies that are out on the 1100 area. More teams should be sent to check the contents of those barrels, and to also locate other barrels and debris that may be of environmental and health concern.

RESPONSE: Extensive characterization of the 1100 Area was undertaken during the RI/FS activities. To the extent that specific areas are in question, DOE and the regulatory agencies request that such areas be brought to the attention of the 1100 Area Unit Managers for one or more of these organizations.

COMMENT 10. The data indicated a concentration of nitrate is migrating toward the Columbia River without any explanation of where it originated from. This also holds true for the TCE plume. More monitored wells should be used and placed in key and representative positions to locate these sources of contamination.

RESPONSE: The report indicates that no one identifiable source of nitrate is known and that a discrete plume has not been identified. The report postulates that the TCE plume originates from a source immediately upgradient of the Horn Rapids Landfill. Information on potential Nitrate and TCE sources is presented in Volume I, Sections 4.7.2.1 and 4.7.2.2 titled "Source Information-TCE Plume" and "Source Information-Nitrate Plume" respectively.

In regard to additional monitoring, the preferred alterative for the EM-1 groundwater (page 8 of the "Proposed Plan" document) calls for additional monitoring wells at the site. As part of the selected remedy, these wells will help confirm predicted behavior of the TCE plume and compliance with remedial goals.

COMMENT 11. The RI/FS should state how this report complies with NEPA, CERCLA, CEQ and the Tri-Party Agreement. Or why it doesn't need to comply. We believe that under the 1992 Amendments to 10 CFR 1058, this area would not qualify for a "Categorical Exclusion" (CX) based upon the cumulative affect of contaminants in and around the area. The RI/FS used the 1991 10 CFR to determine CX which has been amended by the 1992 version.

RESPONSE: Volume I, pages 1-2 and 1-3, along with Table ES-1 address how the report complies with NEPA and CEQ requirements for integration with CERCLA. The citation for the Categorical Exclusion can be found at 10 CFR 1021, dated April 24, 1992.

COMMENT 12. A cultural and archeological study or survey should be conducted on the 1100 area. Not all of the 1100 area is developed or disturbed. If such a survey has been completed, the results should be attached to the report. A preliminary survey conducted by the YIN leads us to believe that on one of the high rises on the 1100 area there was a pathway to an ancient fishing village.

RESPONSE: As part of the CERCLA process, cultural and archeological aspects are evaluated, particularly in the context of mitigating potential impacts to those resources that could be caused by remedial actions. For the 1100-EM-1 in DOE/RL-90-

18 Section 3.7.1.3 cultural resources are discussed and existing reports are referenced. In DOE/RL-92-67 in Volume IV, Sections 1.4 and 1.5 discuss historical and current uses in the other 1100 Areas. In addition, references are given for published reports containing additional information regarding the historical, cultural and archeological resources associated with the 1100 Areas.

COMMENT 13. We believe that the risk management or risk minimization in the report should state why the parameters of achievable standards were used in the report and where those standards came from and why those particular standards were used. Using somebody else's standard of clean-up should be independently reviewed. As an example, the report uses 10 -6 as the upper bound life time risk for cancer. This standard should be reconsidered, especially when there are multiple contaminates. see 45 CFR 400.300(e) (2) (i) (A) (2).

RESPONSE: The NCP at 300.400 (e)(2)(i)(A)(2) states that..."For known or suspected carcinogens, acceptable exposure levels are generally concentration levels that represent an excess upper bound lifetime cancer risk to an individual between 10-4 and 10-6 using information on the relationship between dose and response. The 10-6 risk level shall be used as the point of departure for determining remediation goals for alternatives when ARAR's are not available or are not sufficiently protective because of the presence of multiple contaminants at a site, or multiple pathways of exposure;"

The report, in Appendix K titled Risk Assessment presents details on the development and underlying toxicology used to develop risk based standards. Appendix L titled Applicable or Relevant and Appropriate Requirements presents information on the governing state and federal statutes that provide a legal or regulatory framework for using the various standards discussed within the report. In accordance with standard risk assessment guidance and policy, the cumulative effect of multiple contaminants was evaluated in the risk assessment for the 1100-EM-1.

<u>Here are additional detailed comments on the LFI/FFS:</u>

COMMENT 14. The work plan states that existing waste information, detailed visual inspections, and interviews with site personnel were used for determining what will be remediated. The work plan should rely instead on more monitoring, data collecting, and field investigations.

RESPONSE: The LFI/FFS Report is not a work plan, rather it is an example of a streamlined approach to site evaluation and remedy evaluation. To the extent environmental data were available, it has been incorporated into the report. As indicated in that report, confirmational sampling will be undertaken prior to and during remediation of the waste management units in the 1100-EM-2, 1100-EM-3 and 1100-IU-1 Areas.

COMMENT.15. Although technetium-99 (Tc-99) was found to be of insufficient quantities to warrant further investigation at the 1100-EM-1 area as mentioned in the proposed plan, we feel because of the long half-life and the potential for long term risks to human health and the ecosystem, the work plan should continue to monitor this substance. In addition to technetium, iodine-129 should also be monitored. Usually, where there is technetium, there is iodine-129.

RESPONSE: The 1100 Area monitoring program specifically identified technetium-99 and looked for other radionuclides, including iodine-129. We did not find others. The statement that iodine-129 will also be found with technetium-99 is a generalization and not true for the 1100 Area.

COMMENT 16. Under CERCLA and the Clean Water Act, Trustees are to be included in the remediation process. However, the YIN has been forced to review work plans at the four repositories, one in Richland, WA. This has not happened in the 1100 work plan but other plans. In order for Trustees to have meaningful comments, they should be presented a copy of the reports without having to use a repository.

RESPONSE: Comment noted. All comments received during the public comment period have been distributed throughout EPA, Ecology and DOE for action on the part of the lead agency. All relevant CERCLA documents will be provided to the YIN.

COMMENT 17. The data used in the report shows the average annual precipitation at Hanford as 6.3 inches (15.9cm). The winter of 1992-93 broke all records for precipitation at Hanford, this must have affected the groundwater plumes and the water tables in and around Hanford.

RESPONSE: Continued monitoring of groundwater will show impacts, if any, from recent precipitation. No increase in groundwater levels, attributable to precipitation, has been observed to date. The discussion in Section 6.3 indicates that vegetation on the ground surface plays a large role in preventing percolation of rainwater to groundwater. This, and other factors such as unsaturated zone thickness and evapotranspiration rates, may prevent significant percolation even in rainy years.

COMMENT 18. We note only Monitored Well 3 and Monitored Well 8 were used for monitoring groundwater contamination. More monitored wells should be used. Especially since MW8A is on the western side of the Horn Rapids Landfill (HRL) where there is soil and groundwater contamination.

RESPONSE: Over 50 wells were used for monitoring groundwater contamination in the 1100 Area. These wells and the monitoring results are found in Appendices E and F.

COMMENT 19. Although the data state that it was not possible for the HRL plumes to contaminate the Richland Well fields, there were no data on the degreaser and antifreeze pit that is just west and adjacent to the Richland Well field and flowing toward the Columbia River.

RESPONSE: Data from monitoring wells MW-4, MW-5, MW-6, MW-7 and MW-18 are presented in the report. Those wells cover the area in question.

With both current and planned operation of the North Richland Well Field, the data indicates that groundwater mounding from artificial infiltration prevents the natural groundwater from flowing to the well field. This is discussed in Section 2.4.3.2. Though groundwater from nearby sites eventually travels to the Columbia River, monitoring has not indicated significant groundwater contamination associated with the two sites mentioned.

COMMENT 20. The sample results from surface and subsurface testing for the 1100-3 area listed 16 compounds. However, there are other compounds listed. Please list or explain the discrepancy with the butanone, hexanone, methylene chloride, toluene, bis (2-ethylhexyl) phthalate, beryllium, potassium, and acetone.

RESPONSE: The RI identified 7 surface soil contaminants and 9 sub-surface contaminants. Five contaminants were common to both surface and sub-surface soils, making a total of 11 different contaminants at the site. Sampling was only conducted during the Phase I investigation, and the contaminants listed by the reviewer were not found. There is no discrepancy.

COMMENT 21. The report mentions the anti-freeze tank under the 1171 building. The tank was removed for suspected tank leakage. There was no explanation which lead to the suspicion that the tank was leaking. Also, information used to determine that there was no leaking of the tank should be mentioned in the RI/FS.

RESPONSE: As noted in the report, the information regarding the antifreeze tank was derived from the Hanford Waste Information Data System (WIDS). The RI/FS documents routinely present a summary of relevant information from other published sources.

COMMENT 22. The RI/FS mentions the Discolored Soil Site. It states that the origin or content of the site is unknown. The report should have data on what has contaminated the soil.

RESPONSE: The Discolored Soil Site is the location of an unplanned release of bis (2-ethylhexyl)phthalate. This is noted throughout the 1100-EM-1 documents.

COMMENT 23. The Ephemeral Pool includes PCB's. A concern of this area is that the plume from this site runs right through the Richland well to the Columbia River if the data are correct on the direction of groundwater migration. We note also that the parking lot run-off is located in this pool which would indicate that the pool is "flushed" with water each time there is precipitation.

RESPONSE: There appears to be a misunderstanding regarding contamination associated with the Ephemeral Pool. This area is the location of an unknown release of PCB's, a contaminant that has limited mobility in the environment and has not been detected in the groundwater at the Ephemeral Pool. Therefore, there is no "plume" associated with the site. To the extent that any mobile constituents were present, there would be potential for the soluble fraction to be mobilized by precipitation events. It is note worthy that annual precipitation at Hanford is less than 7 inches per year.

COMMENT 24. "Medical debris" was found during the excavation of a trench in the Horn Rapids Landfill (HRL). No tests were run on the contents of the debris that was found. The only explanation was that no medical laboratory was willing or capable of accepting the materials and that offsite laboratories were unwilling to accept it as there was no certification that it was radiation free. It seems nobody wants to know what is in this debris.

RESPONSE: The medical debris was a small quantity of material that appeared to be expired medicine. The need to further address this debris will be considered during the remedial design.

COMMENT 25. White Crystalline Powder and Stained Soil was also found in the HRL. Again this appears to be a guess without scientific conclusion. Another sample with no chain of custody problems should be conducted.

RESPONSE: As noted in the text in Volume I, analytical tests were undertaken to identify the two constituents. Valid scientific conclusions regarding the identity of the substances were made. The text also describes the nature of the chain of custody problem (not a contract lab program sample) and why it would not adversely affect sample quality assurance.

COMMENT 26. The groundwater investigations in the 1100 area revealed that the "plume" contained contaminants including but not limited to: methylene chloride; acetone, chloroform, toluene, C-12, hydrocarbon, and di-ethylphthalate; and those contaminants that were detected below the MCL's are: chromium, copper, lead, silver, trichloroethane, tetrachloroethene, radium, gross alpha, chloride, and sulfate. Please state in more detail the gross beta and trichloroethane as it shows it to be above the MCL's.

RESPONSE: Volume I page 3-45 and Appendix K page 5-36 provide detailed discussions regarding gross beta activity attributed to Tc-99.

Trichloroethylene was detected at levels above MCL's, but 1,1,1-trichloroethane was not detected above MCL's. The results of trichloroethylene analyses are discussed in detail in Volume I Section 4.0 and in Appendix K.

COMMENT 27. More data should be used to dispel nickel as a contaminant of concern?

RESPONSE: As noted in the report and during the June 30, 1993 1100 Public Comment Meeting, the 1100-EM-1 wells that showed inconsistent elevated nickel concentrations will continue to be monitored for potential impacts to human health.

COMMENT 28. Chromium was detected at a single location within the 1100-2 Paint and Solvent Pit and at the 1100-3 antifreeze and degreaser pit. Although this compound was listed as a Compound of Potential Concern (COPC), the compound should be considered a priority of clean up. The other compounds although listed as non-carcinogen or not enough to be considered COPC, should be a priority of clean up.

RESPONSE: As discussed in the report, chromium was initially identified as a COPC, but was subsequently eliminated from further consideration during the screening process of the risk assessment. For a complete discussion of that process and the criteria for eliminating and/or maintaining the specific COPC's within the risk assessment process, the commentor is referred to Appendix K.

COMMENT 29. At 1100-6 or the Discolored Soil Site, the RI/FS indicates that subsurface testing was not performed due to "field observations". Tests should be run when Chlordane, heptachlor and Bis (2-ethylhexyl) phthalate (BEHP) was detected at the site. Also, present are DDT, zinc, hexanone, and trichloroethane.

RESPONSE: Field observations indicated the extent of the contamination was limited to surface and near surface soils. The results of the BEHP sampling indicated contamination at levels requiring remediation. This fact in turn will lead to additional, confirmational sampling during remediation to ensure achievement of remediation goals.

COMMENT 30. At the Ephemeral Pool, no data on Heptachlor was given as to the position of the contamination. Then during phase II of the investigation no heptachlor was detected. Data should be included to indicate why the Heptachlor disappeared from the site. And although chlordane was detected all over the site, no subsurface sampling was conducted at the site. PCB was also detected in large quantities at the site.

RESPONSE: The Phase I RI indicated heptachlor at 29 ppb in Ephemeral Pool soils. This is an order of magnitude below the MTCA soil cleanup standard of 220 ppb. Risk based pre-screening determined that heptachlor was not a COPC and therefore was not evaluated in the Phase II RI.

Chlordane was detected at low levels at each of the surface sample locations, however, risk based screening during the Phase II RI determined that the concentration levels were not great enough to be of concern. During remediation, field screening and confirmatory sampling and analysis will be performed at depth to determine if and when cleanup goals for PCB are met.

COMMENT 31. It is mentioned in the report that the MCL for TCE and Nitrate will be determined by EPA and Washington State Department of Ecology. The report dies not indicate whether there has been a Superfund Memorandum of Agreement (SMOA) between the EPA and the Washington State Department of Ecology. Nor does the report state whether the areas to be considered (TBC) involved the interested Indian Tribes. According to the National Oil and Hazardous Substances Contingency Plan, Indian Tribes are to be considered states if they qualify under the guidelines. see 45 CFR 300.525(e). The YIN qualifies as a state under those guidelines. The criteria for that determination, especially since alternate points of compliance will be discussed should be expressed the report and the YIN included in those discussions between the EPA and Washington State Department of Ecology.

RESPONSE: MCL's for TCE and Nitrate exist under state and federal statute. Potential points of compliance for achievement of those standards are discussed in the report and the Proposed Plan. As noted on page 37 of the Response to Comments for the Tri-Party Agreement, the jurisdiction for these requirements rests with EPA and Ecology. It is further discussed there how EPA and Ecology intend to involve Indian Tribes in the decision making process.

COMMENT 32. The work plan shows the level of TCE concentration from 1987 to 1992. More information on the level of attenuation changes should be included. And, also where the TCE is going.

RESPONSE: The RI/FS Report contains all available TCE data. Although the data gathered in the ongoing monitoring program will add to our understanding of TCE migration, the available data sufficiently supports the contaminant fate and transport analysis in Chapter 6 and the preferred alternative in the Proposed Plan.

COMMENT 33. The report shows the only place that nitrate and TCE are present is in the groundwater. However the report does not indicate that there are traces of TCE or nitrate in the soil.

RESPONSE: Nitrate is a micro-nutrient, is not considered an environmental threat in soil, and was not analyzed under the soil sampling program. TCE was analyzed for but was not detected in HRL soils for both Phase I and II sampling programs. TCE was

detected in soil gas only, which supports the conclusion that TCE in groundwater is probably the result of an upgradient, offsite release.

COMMENT 34. The report states that the chromium present out at the HRL is trivalent chromium. Please explain how long it takes to transform hexavalent to trivalent chromium and whether that influences your report.

RESPONSE: **The Report in Volume I, Section 5 and in Appendix K discuss the mobility and toxicity of the hexavalent and trivalent forms of chromium. In summary, the trivalent form is an essential human micronutrient, while the hexavalent form can cause adverse human health effects. The hexavalent form is readily reduced to the trivalent form in the presence of oxygen and/or under acidic soil conditions. The rate of transformation is generally very rapid under either condition. The fact that chromium is present in the trivalent form, rather than the hexavalent form is more significant than the rate of reaction.**

COMMENT 35. Page 5-4 of the report states that the assessment of contamination used was the "Industrial scenario risk assessment" based upon the 95-percent Upper confidence limit (UCL). There was no mention whether this was based upon HSBRAM. We recommend that the HSBRAM not be used as it falls short of cultural and ecological concerns. The Baseline residential scenario assessment (BRSRA) should be used.

RESPONSE: **Residential and industrial scenario risk assessments were performed, as well as an ecological risk assessment. The commentor is referred to Volume I, Section 5.1 for a presentation of the summary of the results of the Industrial Scenario Risk Assessment. Additional details are presented in Appendix K. Furthermore, it is stated in the first paragraph of Section 5.1 that the assessment was based upon the HSBRAM. Volume I, Sections 5.3.6 and DOE-RL-90-18 Section 3.7.1.3, respectively, present the findings of the Residential and Ecological Risk Assessments.**

COMMENT 36. The 1E-06 contaminant risks indicate that only Chromium was considered a health risk. All health and environmental risks should be considered.

RESPONSE: **The potential for adverse impacts to human health and the environment was evaluated for numerous contaminants in the 1100 Area. It is unclear what is meant by the first sentence of this comment.**

COMMENT 37. The report states that only terrestrial organisms were considered as groundwater contamination will not likely reach the river. This statement does not consider the plumes upriver. In other words, the cumulative effect. Further, only endangered or threatened species would be considered. The RI/FS should also include sensitive and monitored rare species. Both mortality and morbidity should be monitored for the species.

RESPONSE: **Comment noted. The investigations for the 1100 Area considered contaminants associated with the 1100 Area Operable Units. The commentor is referred to Appendix L for a discussion that includes sensitive and monitored species. As noted in Appendix L, page L-7, due to limitation to the scope of the Ecological Risk Assessment, more specificity concerning assessment endpoints such as mortality and morbidity, was not possible. Additional investigations such as the 300-FF-5 Operable Unit, the various 100 Area Operable Units, and the "Columbia River Impact Evaluation" will consider contaminants that may reach the river.**

COMMENT 38. The report mentions that bis(2-ethylhexyl) phthalate or BEHP is immobile due to strong soil sorption, low water solubility, and low vapor pressure, yet biodegradation is rapid with a half-life of 2 to 3 weeks. It cannot be both unless BEHP continues to be dumped into the ground.

RESPONSE: **It appears that this comment suggests an inconsistency between the physical characteristics of BEHP, the potential half-life associated with biodegradation, and the presence of BEHP at the Discolored Soil Site. Biodegradation under certain "aqueous" conditions has shown to have the potential for a 2 - 3 week half life. It appears that the inference from the comment is that through biodegradation, the BEHP should have been degraded some time ago. The "arid" area where the BEHP release occurred does not represent ideal biodegradation conditions. This is not a function of physical properties of BEHP, rather it is a function of proper conditions for biodegradation.**

COMMENT 39. The report states that polychlorinated biphenyls (PCBS), potential for bioaccumulation is high. However, this depends upon whether the chlorinated biphenyls are lower or higher chlorinated species. Also it is mentioned that PCB's are highly immobile in the groundwater system due to rapid and strong soil sorption. Yet within the same paragraph, PCB to the groundwater is not expected. Please clarify this discrepancy.

RESPONSE: **For contaminants such as PCB's that exhibit rapid and strong soil sorption, impacts to groundwater or transport in groundwater systems in the event PCB's reach groundwater, are not expected.**

COMMENT 40. Arsenic is found in the earth's crust in the form of arsenic-bearing minerals. There are no data on its potential for groundwater contamination. Please give the level of contamination.

RESPONSE: **Potential impacts of arsenic bearing metals in the earth's crust on groundwater systems is a function of mineral species, soil geochemistry the chemistry of the groundwater and surface water systems, as well as local meteorology.**

Arsenic levels from groundwater samples for the 1100 Area are given in Appendix E, Table E-2 "Metals and Cyanide Analytical Data."

COMMENT 41. It is stated that Monitored well 15 is most representative of the Operable Unit Vadose Zone. Please provide data that was used to determine this well as being most representative.

RESPONSE: **Soil properties and similar information from MW-15 were used for the purposes of computer modeling to better estimate percolation through the vadose zone. This well was chosen as a representative well because its construction log contained sufficient detail and because of its close proximity to the HRL.**

COMMENT 42. It is mentioned that the extent of the nitrate plume could not be completely defined and therefore, only a limited transport analysis can be performed. The nitrate plume should be completely analyzed before the report can be considered a final report.

RESPONSE: The analysis of the nitrate contamination satisfies the needs of the RI/FS to gather sufficient information to evaluate potential impacts and candidate remedial alternatives.

COMMENT 43. The Advective transport, mentioned in the report, does not give any data on the TCE plume except that there are no details defining the exact relationship of hydraulic conductivity, host materials, and aquifer pressure. Further, there are no details on the dispersion, degradation, and volatilization effect on an aquifer wide scale.

RESPONSE: The contaminant transport analysis reported in Chapter 6 included consideration of hydraulic conductivity, groundwater pressure gradients, heterogeneity of the host materials, dispersion, and used a conservative assumption regarding volatilization and biodegradation.

COMMENT 44. The report lists the Remedial Action objectives (RAO), however we note that archeological and cultural concerns are not included on this list. These should be listed.

RESPONSE: As noted in the report, RAO's pertain to objectives that will guide the achievement of reduction or elimination of risks associated with the release of hazardous substances. RAO's as such do not include archeological and cultural concerns. However, archeological and cultural concerns are addressed in the report and are discussed in the report in the context of mitigating potential adverse impacts to these values during implementation of remedial actions.

COMMENT 45. The report mentions the relinquishing of the 1100 area for commercial and industrial use. The report should indicate that this would be in line with the City of Richland, WA plans to annex this area. It is recommended that a covenant to the land be included to assure that the cultural and environmental concerns, if any, would be preserved and protected.

RESPONSE: The commentor is referred to Volume II Appendix Land Use for a complete discussion of current and projected City of Richland land use planning. In the event that areas identified for annexation by the City of Richland present specific cultural and environmental concerns to the commentor, those comments should be raised to both DOE and the City of Richland.

COMMENT 46. Although the RI/FS indicated that the plumes were attenuating at a rapid rate, it stopped short of saying that the plumes will not reach the river at a low level of contamination. Please include in the remediation plan how this will be remediated.

RESPONSE: The commentor is referred to the discussion in Volume I, Sections 4 AND 6, and the Proposed Plan for a discussion of migration of TCE in groundwater and the preferred alternative for monitoring attenuation of TCE to levels below regulatory standards.

COMMENT 47. To encourage comments, published notices (ads) should include maps of the affected areas and an explanation of why the unit is of high priority, along with whether USDOE is proposing more study or an actual clean-up action.

RESPONSE: Comment noted. The information requested was contained in the Proposed Plan, but not in the newspaper notice.

COMMENT 48. It is this same necessity for having lengthy access to the Work Plans and supporting documents that renders meaningless the current system of having the work plans and supporting documents supposedly available at an information repository.

So long as these documents are not available for check out or provided totally free of charge (and Mrs. Erickson suggested that we would have to pay for these documents, as does the existing and proposed Community Relations Work Plans), then the public has no meaningful opportunity to comment on them.

RESPONSE: There currently are four information repositories and three additional information centers where interested parties can review Hanford documents. Documents that are made available for purposes of public comment, as well as supporting documents, are routinely placed in these locations prior to the initiation of, and the announcement of associated public comment periods. For many activities, extensions of those comments periods can be made, if requested in a timely manner. In regard to providing free copies of documents to interested parties, federal agencies (and for that matter in the State of Washington state agencies) charge a fee to cover the cost of reproduction additional copies of documents. One of the purposes of information repositories is to provide general access to documents at no charge.

COMMENT 49. Information Repository hours remain limited (there are no non-work hour or lunch time hours for the Richland repository) and prevent even minimal access. Documents are not indexed or shelved in a fashion to enable access at the Seattle Repository. Of course, to review and comment on these large, complex documents requires a large amount of time - preventing the system of having a single document at each information repository from allowing meaningful public review of these documents (since they can not be checked out and if one person is reading a document no one else can).

For the reasons presented above, we ask that each of the comment periods be extended or re-opened with appropriate meaningful opportunity for comment, as evinced by notice and information designed so that a person reasonably desirous of commenting could do so.

RESPONSE: After a telephone call with the commentor, the public comment period on the 1100 Area Proposed Plan was not extended. The commentor knew of additional groups that he thought would want to provide comments. He was told that if these groups provided comments within the next couple of weeks, those comments would still be considered. The repository and library filing systems will be reviewd to determine if and how to better facilitate review of documents at the information repositories.

COMMENT 50. Hanford Clean-Up has been widely touted by USDOE, USEPA and Washington Ecology as an opportunity to demonstrate new and more effective clean-up technologies that will be publicly accepted and usable at Superfund sites across the nation. The proposed plan, however, chooses to rely on incineration and landfilling instead of using new, available technologies to treat and destroy hazardous wastes.

RESPONSE: As noted in the responses to earlier comments (esp. Comment 7), and in Volume I, Sections 7, 8 and 9, and in the Proposed Plan, many other technologies were considered and Supercritical Fluid Extraction, an innovative technology, was pilot tested on BEHP contaminated soils. It was only after evaluating a wide range of technologies for the 1100-EM-1 waste management units that the preferred alternatives were developed. For the other 1100 Operable Units, a focused FS approach that relies on known, proven technologies was undertaken in order to accelerate remediation of those areas.

COMMENT 51. This reliance on landfilling or incineration is inconsistent with Washington's Waste Management Priorities codified in R.C.W. 70.105.150.

RESPONSE: The use of landfilling is not inconsistent with R.C.W. 70.105.150. Both management technologies are included in the listing in the code.

COMMENT 52. This statute has not been properly identified (see general comments) by USDOE, EPA or Ecology as an "ARAR" for the 1100 Area Cleanup Plan or other RI/FS work plans currently out for public comment.

RESPONSE: The commentor is referred to Volume II Appendix M for a complete listing of ARAR's, including R.C.W. 70.105.150.

COMMENT 53. When there exists a viable alternative which would biologically or chemically treat wastes, it is not appropriate to choose landfilling or incineration on the basis of costs, as has been done in the case of the 1100-EM-1 unit remediation for the Ephemeral Pool Soil Site (EPS Site). For the EPS site, offsite landfill disposal has been selected as the preferred alternative on the basis of cost, disregarding proven technologies to destroy PCBs through chemical (non incineration) means and biological means. In fact, proven technology for the destruction of PCBs involving the use of chemical processes that result in harmless salts as the only byproduct, were not even considered amongst the alternatives for this site. This seems entirely inconsistent with Hanford being an example of utilization of new, innovative cleanup technologies.

RESPONSE: As noted in the responses to Comment 50, numerous technologies were evaluated. Chemical dehalogenation is a proven technology and was considered. However, vendors stated that the process is not economically viable unless treatment volumes exceeded 10,000 tons (approximately 6,000 yards). At a maximum, if all PCB contaminated soil was treated, 940 cubic yards would be processed. Cost was a factor in the final evaluation of several technologies, as was implementability and ability of a technology to meet remedial action objectives. For the Ephemeral Pool and HRL, offsite disposal at a permitted facility is considered to provided the best balance among the evaluation criteria.

COMMENT 54. For the Discolored Soil Site (DDS Site) within the EM-1 unit, incineration is actually acknowledged to be twice as costly as bioremediation. Yet, despite Washington State Waste Management Priorities and the oft stated goal of utilizing innovative technologies at Hanford, incineration has been selected as the preferred remediation alternative.

RESPONSE: As noted in the response to Comment 50, numerous technologies were evaluated. Cost was a factor in the final evaluation of several technologies, as was implementability and ability of a technology to meet remedial action objectives. For the Discolored Soils Site, offsite incineration at a permitted facility is considered to provided the best balance among the evaluation criteria. Bioremediation has not been demonstrated to have the capability of meeting cleanup standards.

COMMENT 55. The fact that Bioremediation has not yet been proven capable of meeting ARARs should not cause this technology to be discarded if Hanford is going to be a proving ground for new technology. If this technology work, we will have not only proven a new cleanup tool, we will have cleaned up this site at 50% of the estimated cost for incinerating the wastes.

RESPONSE: Comment noted, the commentor is referred to the previous response.

COMMENT 56. The same issues apply to remediation of the Horn Rapids Landfill. If Hanford is to show environmental leadership, then the goal of the cleanup should be to chemically destroy PCBs to levels well below 50 ppm, which has been shown to be feasible in other cleanups in this State. The MTCA cleanup goal for PCBs, recognized for units EM-2 and EM-3 is just 1 ppm. Leaving 50ppm PCBs in a landfill with no leachate collection and treatment system is, therefore, unacceptable.

RESPONSE: After review by DOE, EPA and Ecology the MTCA C cleanup standard of 5.2 PPM for PCB's in soils under an industrial scenario will be applied to PCB remediation at the Horn Rapids Landfill. The application of the 5.2 PPM cleanup goal will result in a greater degree of potential adverse risk reduction at an additional cost of approximately $125,000. The table below summarizes information that was evaluated during the review by DOE, EPA and Ecology.

REGULATION	**TSCA**	**MTCA C**	**MTCA A**
PCB CLEANUP GOAL	**50 PPM**	**5.2 PPM**	**1.0 PPM**
VOLUME	**31 CY**	**265 CY**	**304 CY**
RESIDUAL RISK	**8x10-5**	**8x10-6**	**4x10-6**
RISK REDUCTION (%)	**50 %**	**96 %**	**99 %**
COST (Estimate)	**$95,000**	**$205,000**	**$300,000**

It is noteworthy that the capping option selected for the Horn Rapids Landfill (HRL) will effectively break the potential exposure pathway associated with PCB's in soils at the HRL. This will effectively mitigate any potential risks associated with residual PCB's in those soils.

COMMENT 57. The 1100 Area must be considered as likely for residential use "in the foreseeable future", according to the Working Group recommendations. The "foreseeable future" was considered by the group to refer to a time period prior to the year 2018 - when all Hanford Clean-Up actions are supposed to be completed.

RESPONSE: As a point of clarification, the working definition presented in the December 1992 report, "The Future For Hanford: Uses And Cleanup" on page 19 defines the foreseeable future as..." this category includes the long-term view and horizon that general usage of the site be available 100 years from the decommissioning of waste management facilities and the closure of waste disposal areas." Furthermore, on that page under timing and priorities the year 2018 was defined as "As soon as possible"

In Chapter 2 *Geographic Area ALL OTHER AREAS* the 1100 area is consistently keyed for Research/Office on usage maps on pages 95 - 98. A complete discussion of potential cleanup scenarios, future use options and timing are presented on pages 99 - 103. These do not include a consideration of the 1100 area as residential in the foreseeable future.

The remedial action goals for all of the 1100 areas, expect the HRL, will allow for unrestricted use.

COMMENT 58. The Draft Plan fails to consider the time element and expectations for "unrestricted use" categorization of the Working Group recommendations. Because of this failure, the following elements of the Plan are flawed:

a. Failure to cleanup contaminated groundwater associated with EM-1 and the Horn Rapids Landfill prior to the time when we can expect legitimate public demands for these areas adjacent to the City of Richland to be released in an "Unrestricted" use scenario. In the Plan, restrictions are required until, at least, the year 2020 (and there is good reason to believe that this is overly optimistic) due to the reliance upon a No Action alternative for groundwater remediation, while available technologies would remediate the groundwater at reasonable cost by the year 2012. Therefore, we urge adoption of alternative GW-2B.

RESPONSE: The preferred alternative for groundwater does not prohibit the use of the EM-1 area prior to achieving MCL's because of the readily available water supply in the nearby Columbia River and in the groundwater upgradient of the HRL/SPC area. The attenuation of TCE to below MCL's was estimated to occur in a range from the year 2007 (unconservative assumptions) to 2017 (conservative assumptions) under the preferred alternative in the Proposed Plan. If this plan is adopted, the groundwater at HRL will likely be free from TCE, in concentrations exceeding MCL's, much sooner than the year 2018.

b. The Plan fails to follow ARARs for the closure of the Horn Rapids Landfill and is also inconsistent with the Future Site Uses Working Group recommendations for making this area available for unrestricted use, with a reasonable expectation of residential or agricultural usage in this area. The ARAR, WAC 173-340-710(6)(c), "Solid Waste Landfill Closure Requirements", requires the Plan to meet State standards for closing landfills, including leachate collection, treatment and capping. Failure to investigate the possibility of additional contaminants and to remediate PCB contaminated soils to a level significantly below 50ppm, makes the proposed action entirely inconsistent with Treaty obligations and rights, and the recommendations of the Future Site Uses Working Group for this area being "unrestricted" before the year 2018 - whether used for agriculture, Tribal rights, or residences. The failure to either remediate the landfill or to cap and install leachate collection/treatment is entirely inconsistent with unrestricted future uses.

RESPONSE: The selected alternative requires closure of the Horn Rapids Landfill in accordance with the requirements for closing asbestos landfills (40 CFR 61). The landfill will be capped in accordance with those requirements (18 inches of clean, random fill and 6 inches of topsoil and reseeded). The HRL was closed in the 1970's, and was not in operation at the time the Solid Waste Rules were promulgated. Closure under the solid waste landfill closure requirements was evaluated (see Alternative HRL-2). It was determined that with the asbestos cap, the HRL would not endanger public health, safety, or the environment, and that additional requirements would impose unnecessary additional cost and delay. Removal of all of the asbestos and other wastes at a landfill of this size is impractical. Without removal of the wastes, exposure to asbestos must be prevented. However, while the remedy does not allow for unrestricted use, a number of potential uses compatible with the maintenance of the required cover are available.

COMMENT 59. W.A.C. 173-340-700(b) sets a Standard Method for determining clean-up levels, which are not to result in additional lifetime cancer risks exceeding one in one million (1x10-6) as mandated by the Model Toxics Control Act. The cumulative risk from a site must be no greater than one in one hundred thousand.

The proposed Plan fails to meet these risk reduction levels.

RESPONSE: The cleanup levels selected are consistent with MTCA. At subunits with only one contaminant of concern, MTCA A levels were selected when available. Otherwise, MTCA B formulas were used to derive the appropriate cleanup concentrations.

COMMENT 60. For the DSS and Groundwater units, post remediation risks are twice those allowed under Washington law. For EPS, the risk is three times what is permitted under Washington law. Further, the risk estimation failed to include the additional risk from Horn Rapids Landfill leachate (claiming :" No exposure and therefore no risk ") despite the failure to require leachate collection and an appropriate cap on the landfill. Thus, the total risk far exceeds that permissible under WAC 173-340-700. This is inexcusable for this Plan, since additional active and effective remediation measures are rejected in the proposed plan on the basis of adding costs.

RESPONSE: The cleanup levels selected for this plan are consistent with MTCA. DSS cleanup levels are based on the MTCA B formula. The cleanup level for the EPS is based on MTCA A tables because only one contaminant is present. The MCL for TCE is the cleanup standard for groundwater which is the MTCA A table cleanup standard based on federal law.

COMMENT 61. We must also point out that residential use must be planned for in this area "in the foreseeable future" - which also requires EPA and Ecology to revise this Plan to require additional active remediation of the landfill and groundwater.

RESPONSE: As noted in the response to Comment 57 above, The Future For Hanford: Uses and Cleanup Report does not make a recommendation of residential use in the foreseeable future for the 1100 area.

COMMENT 62. This is the first Superfund cleanup plan proposed for Hanford. Thus, it is imperative that this Plan be consistent with Washington State regarding appropriate levels of protection from cancer risks from Hanford.

RESPONSE: The cleanup approach presented in the Proposed Plan for the 1100 Area, and selected in the Record of Decision, are consistent with State of Washington regulations for the protection of human health and the environment.

COMMENT 63. Contaminants of concern have been identified in wells downgradient from the Horn Rapids Landfill. For a significant period, USDOE failed to report monitoring results from these wells. There is evidence that the Horn Rapids Landfill is the source of groundwater contamination.

RESPONSE: It is not clear what the commentor is referring to by the statement" For a significant period, USDOE failed to report results from these wells." Further, there is no evidence that the Horn Rapids Landfill is a source of groundwater contamination. The environmental data suggest a source upgradient of the HRL. The commentor is referred to Volume I Section ccc.

COMMENT 64. It is not appropriate to state that the groundwater contamination presents no risks because it is not being currently used. The Hanford Future Site Uses Working Group principles suggest that cleanup in this area allow unrestricted use and that such use will involve unrestricted use of groundwater in the unforeseeable future, although groundwater restrictions are reasonable in the interim.

RESPONSE: Comment noted. For clarification the commentor is referred to Volume I Sections 5.0 and 6.0. The statement regarding potential risk is accurate in that if there is no use of the groundwater for consumption there is no potential exposure. If there is no potential exposure there is no risk. Groundwater modeling indicates that the already low levels of TCE in the groundwater will reach levels below drinking water standards before the year 2018, which is well before the defined foreseeable future by The Future For Hanford: Uses And Cleanup Report. The preferred alternative identifies monitoring and the continuation of existing institutional controls until that time.

COMMENT 65. The Technetium 99 contamination should be viewed as an indicator of the potential migration of other radioactive contaminants, as it has been viewed at other locations onsite. Tc99 levels are a concern. We request further data be provided on the Tc99 levels, migration rates, pathways and potential sources. If the source of this plume is, indeed, another non-USDOE facility, please identify that facility, please identify the status of investigation and explain why this facility is not part of the CERCLA or RCRA closures at Hanford given the cross contamination identified.

RESPONSE: Because Technetium levels were below the relevant health-based risk levels, further investigation of potential source(s) were not pursued. Additional information regrading Technetium 99 will be developed under the ongoing Hanford site-wide surveillance program. Siemens Nuclear Power Corporation, a non-DOE facility, is sampling groundwater for numerous potential groundwater contaminants, including Tc-99. That work is being undertaken as part of a voluntary investigation pursuant to MTCA.

COMMENT 66. Discolored Soil Site, Ephemeral Pool and Horn Rapids Landfill. Defer any cleanup action to a later time when an actual transfer to another owner than the USDOE is near at hand. There is a negligible health and environmental risk now and if more realistic cleanup standards are adopted before disposal of the site by USDOE, a significant money saving will be realized.

RESPONSE: CERCLA requires that continuous remedial actions commence no later than 15 months after the issuance of a Record of Decision. This factor, coupled with interests on the part of both DOE and local community to return properties to the communities for development will prevent the deferral of implementation of cleanup activities. In the event that cleanup activities were deferred, there would be costs associated with continued monitoring of existing releases to the environment, thus reducing any potential cost savings.

COMMENT 67. Groundwater. Use the existing wells to monitor the TCE plume, and do not install new wells along Geo. Wash. Way pending future monitoring results. Continue the restriction on use of the groundwater for drinking.

RESPONSE: The additional monitoring locations are based upon the existing results. The final locations will be refined during remedial design. The preferred alternative includes the continuation of existing City of Richland groundwater restrictions.

COMMENT 68. Soil and debris. As for EM-1, defer any actual field cleanup to later when there is a near term transfer of ownership at hand. In any case, it really seems dumb to drum up and ship contaminated soil and debris out of state when there will be so much radioactive contaminated soil and debris buried on-site. This is another administrative problem area that raises costs without any valid reason. As for groundwater, just restrict any use if it is found to be contaminated. Hopefully, research will find some cost effective cleanup techniques.

RESPONSE: As noted in the previous comments and responses, there are costs associated with deferring cleanup of contaminated areas.

COMMENT 69. The Executive Summary could be read to imply that the RI for the entire 1100-EM-1 Operable Unit was coordinated and negotiated with SPC. A more accurate characterization is that SPC's well construction and water-quality sampling program were designed to be consistent (to the extent feasible) with that conducted by USDOE at the Horn Rapids Landfill (HRL). Additionally, SPC and USDOE coordinated scheduling of water-quality sampling and water-level measurement activities at the HRL and SPC facility and shared results with each other.

RESPONSE: Comment noted. An Errata Sheet has been distributed for the RI/FS to address this and other comments. The Errata Sheet is also included in this Responsiveness Summary.

COMMENT 70. The Executive Summary indicates that the highest TCE concentration in groundwater in the 1100 Area was 110 parts per million (ppm). This is erroneous; the highest 1100 Area concentration was 1100 parts per billion (ppb), not ppm.

RESPONSE: Comment noted. An Errata Sheet has been distributed for the RI/FS to address this and other comments. The Errata Sheet is also included in this Responsiveness Summary.

COMMENT 71. The summary of the SPC pumping test contains some errors. Please see SPC comments transmitted on February 2, 1993 for recommended changes.

RESPONSE: Comment noted. An Errata Sheet has been distributed for the RI/FS to address this and other comments. The Errata Sheet is also included in this Responsiveness Summary.

COMMENT 72. The text in Appendix F does not adequately characterize the uncertainty regarding the historic water-quality data. Please see the February 2, 1993 SPC comment letter for recommended changes.

RESPONSE: As discussed in previous reviews that included personnel and representative of SPC, the discussion in Section 3.0 of Appendix F is specific and covers the subject adequately.

COMMENT 73. Throughout the text, references are made to SPC's property as a possible source of the TCE-contaminated groundwater plume underlying the HRL. However the text does not adequately characterize the uncertainty regarding the sources of TCE at the HRL and dates during which TCE may have been released. Although TCE was used during Hypalon™ repair and relining efforts at SPC, there are no known or documented spills or releases of TCE in any quantity on SPC property, and in particular in quantities whereby groundwater may have been adversely impacted. In addition, no evidence of TCE contamination was discovered by SPC in its soils investigation efforts. The RI/FS must be clear that the discussion of TCE sources is based on hypothetical environmental releases from past TCE usage. As such, a relatively high level of uncertainty exists. Please see comments transmitted by SPC on February 2, 1993 for further discussion.

RESPONSE: The discussion on potential groundwater contamination sources focuses on the available data, historical record, and physical environment. The associated uncertainty is reflected in the wording used in the report.

COMMENT 74. The text (page 4-47) suggests that the nitrate plume from the HRL extends into the 300 Area. Later, the same paragraph indicates that is not unlikely that the nitrate in the 300 Area may have come from a different source west or northwest of the 300 Area. Our understanding, based upon previous discussions with the U.S. Environmental Protection Agency (USEPA), Washington State Department of Ecology (Ecology), and U.S. Geological Survey, is that because of multiple potential source areas and a complex groundwater flow system in the 300 Area, the source of nitrate in groundwater cannot be determined at this time.

RESPONSE: The source of nitrate in the 300 Area groundwater cannot be determined at this time. Primary potential sources of nitrate in the groundwater at the HRL/SPC area are listed in Section 4.7.2.2 as the SPC facility and the HRL. Because nitrate migration was not analyzed in detail, further definition of potential nitrate sources was not pursued.

IV. REMAINING CONCERNS. This section discusses community concerns that the agencies should be aware of as they prepare to undertake remedial designs and remedial actions at the 1100 Area Operable Units.

Commentors expressed concern that opportunities for the development and utilization of innovative technologies be evaluated by the agencies during cleanup activities at Hanford. In addition, commentors indicated a strong desire for more the focusing of resources on more cleanup activities and less on studies. An emphasis on restoration of natural habitat and minimizing disturbance of cultural and historical resources in areas disturbed by remedial actions was made by several commentors. In areas that are currently commercial or industrial in nature, an emphasis was placed on completion of cleanup to allow for the continuation of economic growth in those areas.

ERRATA SHEET FOR INCLUSION IN THE RI/FS

The following corrections apply to the Final Draft Remedial Investigation/Feasibility Study for the 1100-EM-1 Operable Unit, Hanford report.

Page ES-1, sixth paragraph, third sentence. The wording in this sentence should read "Investigation and analysis of contamination, especially groundwater, has involved coordination with Siemens Power Corporation, who is independently investigations contaminated groundwater beneath its facility."

Page ES-3, second full paragraph, third sentence. The trichloroethene concentration in parenthesis should read (up to 110 ppb) instead of (up to 110 ppm).

Page 2-33, second full paragraph, third sentence from the end of the paragraph. the conversion for transmissivity estimates in parenthesis should read "(200,000 to 255,000 gallons per day per foot)" instead of "(180,000 gallons per day per foot)."